CHAPTER

15

PURCHASING A PC OR BUILDING YOUR OWN

In this chapter, you will learn:

- Some guidelines to use when purchasing a PC
- Reasons why you might choose to assemble a PC yourself
- How to assemble a PC from separately purchased parts

This chapter presents guidelines to follow when purchasing a new PC and also presents detailed, step-by-step procedures for building a PC from parts. If you need a computer for your own personal use, consider assembling it yourself, not necessarily to save money, but to benefit in other ways. If you don't want to build a PC, you must choose between purchasing a brand-name PC or a clone.

After-sales service and support are probably the most important criteria to consider when purchasing a PC. In general, a brand-name PC (such as IBM or Compaq) might cost more, but will provide better service and support than a PC built with parts manufactured by companies whose names you don't recognize. Important reasons for choosing to build your own PC rather than buying a comparable preassembled one are the knowledge gained and the fact that you will have complete control over every part purchased to make your own customized integrated system.

Selecting a Personal Computer to Meet Your Needs

So far, this book has been chock-full of information to help you make decisions concerning which computers, peripheral devices, operating systems, and software to buy and how to manage and maintain them once they are yours. However, hardware and software are changing daily, and it's important to stay informed if you make buying decisions or give purchasing advice on an ongoing basis. You can choose one of three alternatives when selecting a PC: buy a brand-name PC, buy a clone, or buy parts and assemble a PC yourself—which, in effect, results in your own personally designed clone.

A **brand-name PC**, sometimes called an IBM-compatible PC, is a PC manufactured by a company with a recognizable name such as Compaq, Packard Bell, Dell, Gateway, or IBM. A **clone** is generally understood to mean a PC that has been assembled by a local company with parts manufactured by several companies. (The terms *brand-name PC* and *clone* once had entirely different meanings. Originally, the one and only brand-name PC was the IBM, and all other personal computers were called clones.) There are advantages and disadvantages to purchasing both brand-name and clone PCs, in the areas of warranties, service contracts, and ease of obtaining replacement and additional parts. For instance, while it may seem advantageous that brand-name PCs and most clones come with some software already installed, the software is not necessarily standard, brand-name software. The preinstalled software can be any variety of shareware, unknown software, etc., and the documentation and original installation disks for the software may not be included in the total package.

When selecting a computer system that will include both hardware and software, begin by taking a high-level view of the decisions you must make. Start by answering these questions:

- How will the computer be used now and in the future?
- What functionality do you want the computer to have (within its intended use)?
- What hardware and software do you need to meet this functionality?
- What is your budget?
- If you determine that a clone meets your needs, do you want to assemble it yourself?

In order to make the best possible decision, consider the first question to be the most important, the second question the next most important, and so on. For example, if you intend to use the computer for playing games and accessing the Internet, the functionality required is considerably different than for a computer used for software development. Listed below are some examples of possible answers to the first question:

- To access the Internet
- To play games
- To use software stored on a file server while connected to a LAN
- For Windows software development
- For business applications on a standalone PC or on a LAN
- For computing-intensive engineering or mathematical applications such as CAD/CAM

- To provide help-desk support with online remote control of other computers
- For multimedia presentations before large and small groups
- For use in a retail store (including cash register support)
- For network administration

After you have identified the intended purpose of the computer, list the functionality required to meet the needs of the intended purpose. For example, if the computer is to be used for playing games, some required functionality might be:

- Ability of the hardware to support game software
- Excellent video and sound
- Sophisticated input methods

If the computer is to be used for Windows software development, required functionality might include:

- The ability to support the standard hardware and software environment that most customers using the developed software might have
- The ability to run software development tools and hardware to support the software
- A comfortable keyboard and mouse for long work hours
- A removable, high-capacity storage device for easy transfer and storage of developed software
- Reliable warranty and service to guarantee minimal "downtime"

Once the required functionality is defined, the next step—defining what hardware and software are needed—is much easier. For example, if a comfortable keyboard designed for long work hours is a required functionality, begin by researching the different types of keyboards available, and try out a few in the stores if necessary. It would be a mistake to purchase the cheapest keyboard in the store for this intended purpose. However, for game playing, an expensive, comfortable keyboard is probably not needed because most games use other input devices. Spending your resources on a sophisticated joystick probably makes more sense.

As noted above, the least possible amount of downtime is a required functionality for software development. This is also true for many business-use computers, and it is the most important reason a business chooses a brand-name computer over a clone.

Purchasing a Brand-Name PC vs. a Clone PC

As you have most likely noticed, brand-name PCs generally cost more than clone PCs with similar features. One reason for this is that you are paying extra money for after-sales service. For example, an IBM PC comes with a three-year warranty, a 24-hour-service help line with a toll-free number, and delivery of parts to your place of business. A clone manufacturer might also give good service, but this may be due to the personalities of a few employees, rather than to company policies. Most likely, clone company policies are not as liberal and all-encompassing as those of a brand-name manufacturer. Typically, most brand-name manufacturers provide

additional support not provided by clone manufacturers, such as functional Web sites, updated drivers and utilities, and online troubleshooting or user manuals.

On the other hand, many brand-name manufacturers use nonstandard parts with their hardware and nonstandard approaches to setting up their systems, making their computers more proprietary than clones. **Proprietary** systems are ones that are unique to a particular vendor (or proprietor), often forcing customers to use only parts and service from that vendor. One of the most common ways for a brand-name manufacturer to make its computer more proprietary is to put components directly on the system board rather than use more generic expansion cards. Remember from earlier chapters that an easy way to tell if ports are coming directly off a system board is to look at the back of the PC. If ports are aligned horizontally on the bottom of a desktop PC or vertically down the side of the tower-case PC, these ports most likely come directly off the system board, and the board is more likely to be proprietary.

For example, a brand-name system can include video, sound, or network logic on the system board rather than on an expansion card. Or, rather than being updated by a setup program in BIOS, the CMOS setup program might be stored on the hard drive. The shape and size of the computer case might be such that a standard system board does not fit; only the brand-name board will do. These practices can make upgrading and repairing brand-name PCs more difficult, because you are forced to use the brand-name parts and brand-name service. Also, in some areas of the country, it might be difficult to find authorized dealers and service centers for brand-name PCs.

Selecting Software

When selecting software, review the required functionality you identified, which drives your decisions about software selection. Choose the operating system first, according to guidelines presented in Chapter 2. When choosing applications software consider these questions:

- What do you want the software to do? (This will be defined by your answer to the functionality question above.)
- Is compatibility with other software or data required?
- Is training available, if you do not already have the skills needed to use the software?
- How good is the program's documentation?
- What are the company's upgrade policies?
- How well known or popular is the software? (The more popular, the more likely you'll find good training materials, trained people, technical support, and other compatible software and hardware.)

Caution is in order if you are buying a brand-name or clone computer that has preinstalled software that you are not familiar with. The software may not provide the functionality that you need, and may not have good documentation or reliable upgrades or support. Unless you feel that you have the skill to manage this software, you're probably better off staying with mainstream-market software. One way to identify which brand of software is the most prevalent in the industry is to browse the computer books section of a local bookstore, looking for the software that has the most "how to" books written about it. Also see trade magazines, the Internet, and your local retailer.

Selecting Hardware

The two most important criteria to consider when selecting hardware are compatibility and functionality. Begin by considering the system board. (See Chapter 3 for more information about how to select one.) Here are other topics you should consider:

- If you plan to use Windows 9x on a PC, choosing a PC that is made up of 100% Plug and Play components is of value, but not necessary. Be certain, however, that the BIOS is Plug and Play.
- If you intend to use the PC for multimedia applications, including games, you will want MMX technology or better for the CPU, and plenty of memory and drive space.
- If you plan to use the PC for heavy network use, buy a PC with plenty of processing power.
- If Internet access is important, don't skimp on the modem, and, if it's an external modem, be sure to include a high-speed serial port.
- When selecting a computer case, keep in mind that tower cases generally offer more room than desktop units, and are easier to work with when adding new devices. Make sure the case has a reset button and, if security is an issue, a key lock in order to limit access to the inside of the case. Some cases even have a lock on the floppy drive to prevent unauthorized booting from a floppy disk.

Selecting a Total Package

When selecting a complete computer package, including hardware and software, consider these points:

- Are the hardware and software compatible with those found on the general market? (For example, if you wanted to upgrade your video card or word processor, how difficult would that be?)
- What is the warranty and return or exchange policy?
- What on-site or local service is available? Do you know of anyone who has used this service, and was it satisfactory?
- Is the system Energy Star compliant? (For information about Energy Star, see Chapter 11.)
- What software comes preinstalled?
- What documentation or manuals come with the system?
- Does the manufacturer maintain a Web site with useful support features, utilities, and updates?
- Does the system board allow for expansion of both DRAM and SRAM?
- What expansion slots are not being used? (Always allow for some room to grow.)

- Can features such as video on the system board be disabled if necessary? (Refer back to Chapter 3 for other guidelines on selecting system boards.)
- How much does the system cost?

When considering price, keep in mind that high-priced to middle-range-priced PCs are most likely to be network-compatible and easily expandable; they offer a broader range of support, and have had extensive testing of vendor products for reliability and compatibility. Low-priced PCs may not have been tested for network compatibility; they offer a limited range of support, and the quality of components may not be as high.

When considering preinstalled software, remember that sometimes unneeded software is more of a hindrance than a help, needlessly taking up space. For example, it is not uncommon for a brand-name computer to come with three or four applications for Internet access (for example, America Online, CompuServe, Prodigy, and Microsoft Network) because of licensing agreements distributors have with online providers. Typically, only one is needed. Sometimes having more than one on your computer can cause problems.

Preparing to Build Your Own PC

Assembling your own PC takes time, skill, and research, but it can be a great learning experience. You might even want to consider it your "rite of passage" toward being a PC technician. All the skills needed to be a PC technician are tested: research, knowledge of user needs and the computer market, planning, organization, patience, confidence, problem solving, and extensive knowledge of both hardware and software. If you intend to become a corporate-level technician, you most certainly should put together at least one whole PC before starting your first job.

However, don't build your PC in order to save money, because you probably won't. The total price of all parts usually about equals the price of a comparable clone PC that is prebuilt. Here are a few good reasons to assemble your own PC:

- The whole process can be quite fun.
- Knowledge is power. The knowledge and experience gained in researching the parts to buy, studying the documentation, and finally assembling the PC can't be overemphasized.
- When you buy all the parts and software for a PC individually, you are also getting the documentation for each hardware component. This is most likely not the case when you buy a PC already assembled. If you plan to upgrade your PC later, having this documentation can be very valuable.
- Many prebuilt PCs come with software already preloaded. You may not receive the original CDs or disks or the documentation for these programs, which can be a problem when you try to maintain your system. However, when you buy each software package individually, you have the installation disks, CDs, and documentation.

- When you purchase each computer part individually, you are more likely to understand exactly what you are buying, and you can be more particular about the selection of each component. You have control over the brand and features of each component in the PC.

Here are a few reasons why you might *not* want to build your own PC:

- If you are in a rush to get a PC up and running, assembling your own is probably not a good idea, especially if you are a first-time builder. The process takes time and requires patience, and the first time you do it, you most likely will make a few mistakes that will need to be resolved.
- Individual parts may be warrantied, but if you build your own PC, there is no overall warranty on the PC. If a warranty or a service agreement is important, then look for a ready-built PC with these services included.
- Clone PCs have been tested to assure that individual components are compatible. When building your own PC, it is possible you might select components that are incompatible. For this reason, buy quality mainstream components to best ensure compatibility.
- Don't plan to assemble a PC for the first time unless you have access to an experienced technician or a technical service center you can consult if you encounter a problem you cannot resolve. For example, you may buy all the parts from a store that has a service center. The store may offer to assemble the PC for you for a charge ($50 to $75 is about right). If you find you cannot resolve a problem, you can always go back to the store for this service.
- Remember, don't assemble the PC to save money, because you probably won't.

Getting Ready for Assembly: Selecting Parts

If you have decided to buy parts and assemble a PC, expect the process to take some time. The system board and expansion cards are full of jumper switches, connections, and ports, and the documentation must be carefully read to determine just how to configure the system board and all components to work together. Technicians in service centers can assemble a PC in less than an hour—but they have already assembled the same group of parts many times!

Planning the assembly of a PC is like packing for a camping trip to a remote location. You must plan for everything you will need before you begin. As you select and purchase each part, two things are important: part functionality and compatibility with other parts.

Almost every computer needs these essentials: system board, CPU, RAM, hard drive, CD-ROM drive (or you can substitute a DVD drive or CD-RW drive for added functionality), floppy drive, case, power supply, video card, monitor, keyboard, and mouse. And, most likely, you will also want a sound card and modem. Make careful and informed decisions about every part you buy. Selecting each component requires reviewing your functionality, compatibility, and budget needs and determining what parts meet your criteria. Select the system board first, and then select the rest of the parts around this one most important component. Remember from Chapter 3 that the Intel chip set is preferable to other brands of chip sets.

When selecting parts, including the system board, carefully examine the documentation. Look for good documentation that you can understand without struggling. When buying parts for your first assembly, you should probably not use mail order. Buy from a reputable local dealer who will allow you to examine a part and look at the documentation, and who is willing and able to answer any technical questions you may have. Know the return policy of the store and the manufacturer's warranty for the part.

If you can buy the system board, CPU, and memory from the same dealer, who can help you determine that all three are compatible, do so to avoid later problems with compatibility. The documentation for the system board is quite valuable. Make sure it's readable and complete. Does the CPU need a voltage regulator, heat sink, or fan? Ask the dealer for recommendations, and read the documentation for the CPU. Often a dealer will sell a system board with the CPU and fan already installed and jumpers on the system board set correctly.

After you have selected the system board, RAM, and CPU, select the case and accompanying power supply. Remember the two rules: the case must meet your predetermined functionality, and it must be compatible with other parts (especially the system board). Next, select the hard drive and other drives. Does your BIOS on the system board support the IDE or SCSI hard drive selected? Is there an IDE adapter on the system board? Are connections available for the CD-ROM drive, floppy drive, removable drive, and the like? If the video logic is not included on the system board (for clone system boards it probably will not be), select the video card next, and make sure that you have an AGP or a PCI slot to accommodate it. Next, select the hard drive, CD-ROM drive, and floppy drive and then the peripherals, including a mouse, keyboard, and monitor.

Getting Ready for Assembly: Final Preparations

When all parts are purchased, prepare for the assembly well. Prepare a work area that is well lit and uncluttered. Read all the documentation and plan the assembly through, from beginning to end, before you start. If you have questions or are unsure how to proceed, find the answers to your concerns before you begin. For example, if you're not sure how to set the jumpers on the system board, even after you have read the documentation, take the documentation to your technical support (dealer, service center, a knowledgeable friend) and ask for help in interpreting the settings in the documentation before you start the work. Often you can find a detailed diagram of the system board on the manufacturer's Web site complete with proper settings for specific CPUs.

While working, don't get careless about protecting against static electricity (review the safety precautions at the beginning of this book). Always use the ground strap on your wrist.

Building a Personal Computer, Step by Step

This section is a step-by-step, detailed description of building a Pentium II PC designed for multimedia applications, from parts—including a hard drive, floppy drive, DVD drive, Zip drive, modem, sound card, video camera, and SCSI card to support a scanner. Depending on

what you have decided you want your computer for, and what functionality and budget you are operating with, you may choose to build a slightly different PC, with a different CPU and different parts. We selected this particular Pentium II system board so that you can see a typical configuration using jumpers. At the end of the chapter, you will see a Pentium II system board that has a much easier jumper-free configuration. While we do not have the space to provide instructions on the assembly of many different PCs, the examples below will provide you with background and guidance, and demonstrate how to approach the task at hand.

The text describes some of the problems actually encountered during an assembly. I wish I could invite you to work beside me, reading the documentation for that jumper setting, deciding just which card should go in which slot for the best overall fit, and enjoying the pleasure of turning on the PC and seeing it boot up for the first time. However, the best I can do is invite you into the experience through this book. My hope is that you will one day have the opportunity to experience it for yourself.

Overview of the Assembly Process

Once the research is done and the parts purchased, organize everything you'll need to assemble the PC. Have the parts with the accompanying documentation and software available, together with your PC tools. You'll need a safe place to work, with a ground mat and ground strap. Be careful to follow all the safety rules and precautions discussed at the beginning of this book. Work methodically and keep things organized. If you find yourself getting frustrated, take a break. Remember, you want the entire experience to be fun!

The parts purchased for the PC before the beginning of the assembly are listed below. Since the system includes a DVD drive that can read a CD, a CD-ROM drive is not needed. The parts to be installed inside the case are shown in Figure 15-1.

- 17-inch monitor
- ATX case with power supply
- System board
- Pentium II CPU that runs at 350 MHz
- One 64-MB DIMM
- AGP video card
- Hard drive
- Floppy drive
- DVD drive kit
- Zip drive
- Sound card
- Modem card
- SCSI host adapter (to interface with a scanner)
- Video camera with USB connection
- Mouse and keyboard

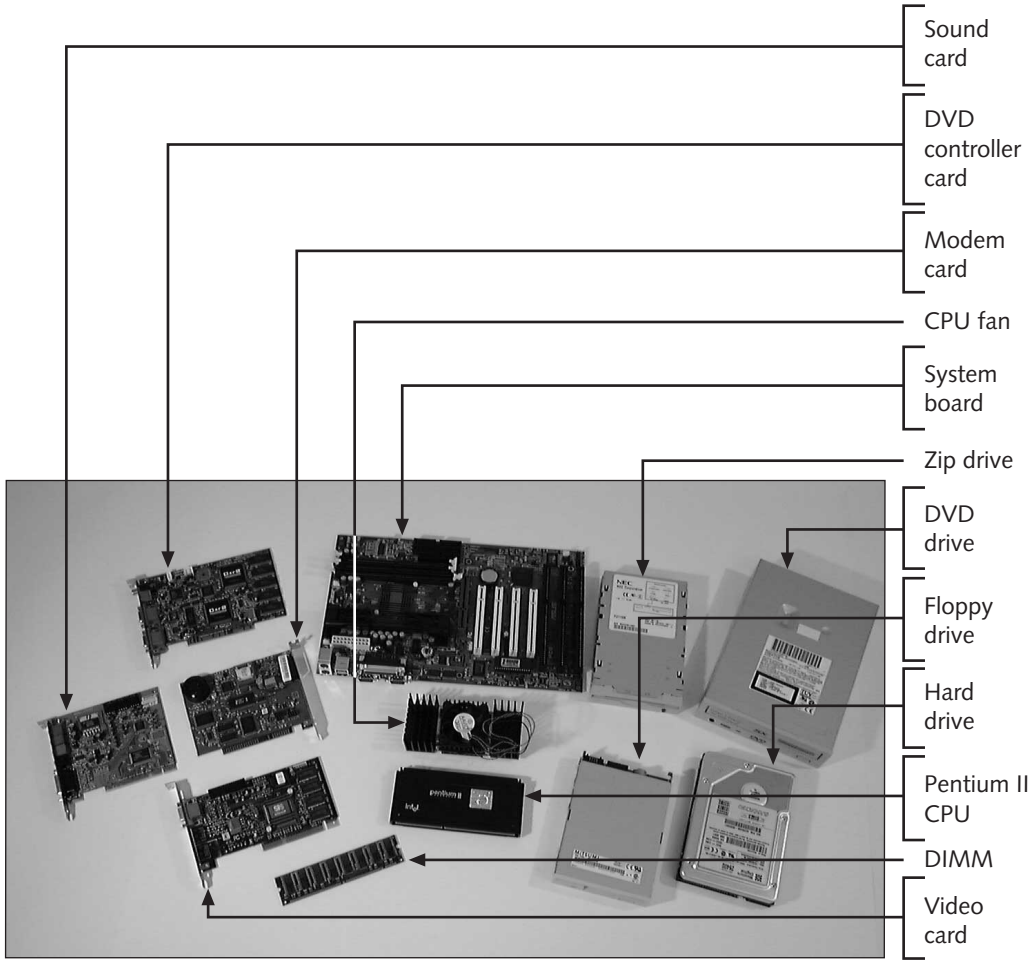

Figure 15-1 The parts of a PC before assembly

The general steps to assemble the PC are as follows:

1. Set the jumpers on the system board.
2. Install the CPU and CPU fan.
3. Install RAM on the system board.
4. Verify that the system board is working by performing a memory test.
5. Install the system board in the computer case.
6. Connect the power cord and front panel connectors to the system board.
7. Install the floppy drive, hard drive, and Zip drive.
8. Install the video card, modem card, sound card, and SCSI adapter.
9. Install the DVD subsystem, including DVD drive, controller card, and cords.
10. Connect essential peripherals.
11. Install the operating system.
12. Connect remaining peripherals and install device drivers.

Step 1: Setting the Jumpers on the System Board

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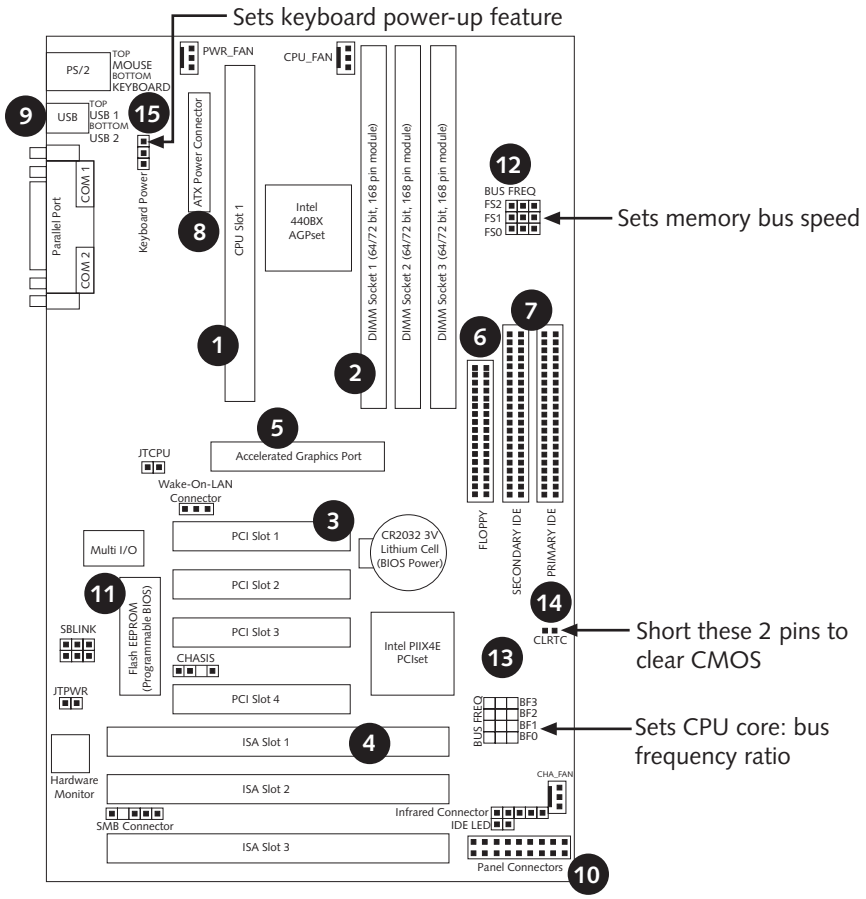
This section describes how to set jumpers on the system board to configure hardware; the jumpers and their functions are listed in Table 15-1. Figure 15-2 shows a diagram of the system board with the main parts identified. When doing an installation, read the system-board documentation carefully, looking for the type of information in the table, and set the jumpers according to the hardware you will be installing, which may differ from what appears here.



1. CPU Slot 1
2. DIMM Sockets 1,2,3
3. PCI Slots 1,2,3,4
4. ISA Slots 1,2,3
5. AGP slot
6. Floppy drive connector (34 pin)
7. Primary/secondary IDE connectors (40 pin)
8. ATX power connector (20 pin)
9. External ports
10. Panel connectors
11. Flash EEPROM BIOS
12. Jumpers, bus speed
13. Jumpers, CPU multiplier
14. Jumper, clear RTC
15. Jumper, keyboard power-up

Figure 15-2 System-board layout including jumper definitions

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For example, although this system board does not require that a jumper be set to indicate what type of CPU is installed, many system boards do have a jumper for this purpose. Also, a system board might require you to use jumper settings to regulate the voltage to the CPU. When making this kind of selection, read the documentation that comes with the CPU to learn the voltage requirements. If the system board has L2 cache, then there will most likely be jumper settings to indicate how much cache memory is installed.

Table 15-1 Jumper settings on the system board

Jumper Groups on the System Board	Description
CPU memory bus frequency (Item 12 in Figure 15-2)	This group of nine pins controls the speed (frequency) of the bus between the CPU and memory.
CPU core bus frequency multiple (Item 13 in Figure 15-2)	This group of 12 pins controls the ratio of CPU core speed to memory bus speed (i.e., the multiplier).
Clear CMOS RAM (Item 14 in Figure 15-2)	This is one jumper, which, when closed, will clear CMOS settings including the real time clock.
Keyboard power-up (Item 15 in Figure 15-2)	This jumper group consists of three pins with two possible settings to enable and disable the feature to allow the Spacebar on the keyboard to power up the PC. Requires a power supply that supports the feature.

One of the most time-consuming steps of assembling a PC can be setting the jumpers on the system board, or rather studying the system-board documentation to learn how to set the jumpers. (Once you know how to set them, doing so is quick and easy.) The documentation for the system board used here is really very good. Every jumper is clearly marked, and the settings for the jumper are clearly explained. That is not always the case.

First, locate the four jumper groups on the system board (see Figure 15-2), as listed in Table 15-1. Each jumper group will be discussed in turn to determine what it does and what settings it should have. As each jumper set in the documentation is examined, one setting for each jumper group will be marked as a default setting. This is usually the factory setting (the setting on the system board when it is shipped). However, if you want to use the default setting, check to see that the jumper is set as indicated, because sometimes the factory sets the jumpers differently from what is listed in the documentation as the default.

Also, occasionally the wrong documentation will be shipped with a system board, or the documentation will have an error. After power-up, if you have problems because the system is incorrectly sensing your system-board configuration, double-check your settings. If you don't find an error, suspect the problem may be with the documentation. If your system-board manufacturer has a Web site, check it for the latest information about jumper settings.

Jumpers are set to the closed position by placing a small cap across a pair of pins. An open jumper has no cap across the pair. If you want to set the jumper to open, you can place the unused cap on one of the two pins, so you won't lose it. This is called "parking" the jumper. Set the following jumpers:

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Jumper to Clear CMOS RAM

Closing the "Clear real-time clock" jumper (labeled CLRTC in the documentation) clears CMOS RAM, which may be necessary in order to remove a forgotten password or erase improper, but forgotten, CMOS changes. To clear CMOS RAM, turn off the PC and unplug the AC outlet. Short the CLRTC jumper by placing a cap over it. Remove the cap and power up. When you boot, enter CMOS setup to reenter setup preferences. Leave the jumper open (uncapped) for now. Park the jumper cap on one pin.

Jumper Setting for Keyboard Power-Up

The keyboard power-up feature allows you to power up the PC by pressing the Spacebar on the keyboard. In order to use this feature, your power supply must support it. If the documentation for the computer case and power supply does not tell you if the feature is supported, disable it. If it is enabled and the feature is not supported by your power supply, the system will not come on.

Figure 15-3 shows the two different configurations for these jumpers, where dark shading over two pins indicates that they are closed. The darkened pins will always be in pairs, because a jumper cap closes two pins by connecting the pair. Also, sometimes in documentation, pin 1 is marked as a square and other pins as circles. On the system board, a very small 1 is sometimes imprinted next to pin 1 in a group of pins, or the name of the group is imprinted next to the entire group of three or four pins. Set the jumper to disable the keyboard power-up feature:

- Locate the jumper group on the system board.
- Place the jumper cap to disable the feature, as indicated in the documentation (in this case across pins 1 and 2).

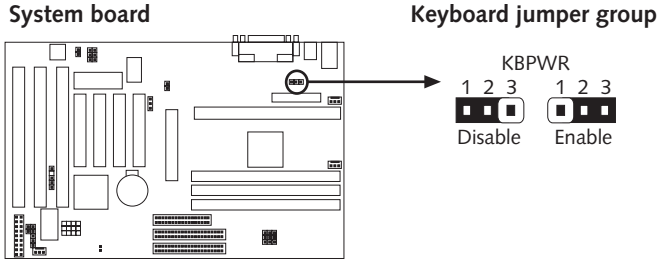

Figure 15-3 Keyboard power-up feature is enabled or disabled with this jumper group

Jumper Settings for CPU Bus Frequency and CPU Multiplier

Before we continue with setting jumpers, a quick review of terms and relationships is in order. System-board documentation does not always use the most common terminology, which can lead to confusion. Also, terms used on one page or diagram might not be the same as the terms used on another page or diagram. Now, let's turn to our review: Recall that the CPU speed is the internal speed of the processor and is really a "frequency" rather than a "speed," because it is rated as MHz (million cycles per second). Also recall that the CPU communicates with

A+CORE 1.2

RAM over the memory bus, which is sometimes called the CPU bus, the clock bus, the system-board bus, the host bus, the system bus, and so on. The two most popular ratings for this memory bus are 66 MHz and 100 MHz. Also recall that the memory bus runs in sync with the CPU, and the CPU speed is determined by multiplying a factor times the memory bus speed, called the multiplier. This system-board documentation expresses that multiplier as a ratio, which, of course it really is. The documentation expresses this ratio using the colon, like this: "CPU core:bus frequency." In our example, 350:100 yields the multiple of 3.5 for a 350-MHz CPU and 100-MHz memory bus speed. And finally, recall that the PCI bus also runs in sync with the CPU, but at half or a third the rating of the memory bus.

As seen in Figure 15-4, this system board can run at recommended speeds of either 100 MHz or 66 MHz and can support multipliers of 3.5, 4.0, 4.5, and 5.0. As you can see from the jumper settings in the lower part of Figure 15-4, the jumpers can also be set so that the bus runs as high as 133 MHz, although the system-board documentation says that this speed is not supported by the Intel chip set on the board and is not guaranteed to be stable. The board accommodates Pentium II or Pentium II Celeron CPUs rated from 266 MHz to 450 MHz. In order to use the faster bus speed of 100 MHz, the CPU must be rated for at least 350 MHz.

The jumpers on this board must be set to determine the memory bus speed and the multiplier. Begin with the rating of the CPU, which in our case is 350 MHz. Look in Figure 15-4 and select the correct row in the diagram for the 350 MHz CPU. From that row, read that the ratio (or multiplier) must be 3.5 and the bus frequency (memory bus speed) must be set to 100 MHz. The settings for each jumper are written at the end of this row, but it's easier to locate them in the diagram in the lower part of the figure. To set the jumpers for the CPU multiplier (see the jumper part of the diagram), we selected the fourth group of the first row of possible selections because it is labeled with 3.5, which is the multiplier we need. For the bus frequency, select the fourth group in the one row of possible selections, because it is labeled with the appropriate speed. You have selected the multiplier to be 3.5, bus speed to be 100 MHz, and PCI bus speed to be 33.3 MHz. (For the PCI selection, look carefully at the very last row of the figure labeled PCI.) The PCI bus will be running at one-third the speed of the memory bus.

To complete this step of setting CPU bus frequency and CPU multiplier (your system board may have an entirely different grouping of jumpers to specify memory bus speed and multiplier):

- Locate the jumpers on the system board.
- Set them just as they are in our selections.

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1. Begin with the speed of your CPU
2. The CPU speed determines the ratio (multiplier)
3. The CPU speed also determines the bus frequency

Set the jumpers by the iInternal speed of your processor as follows:

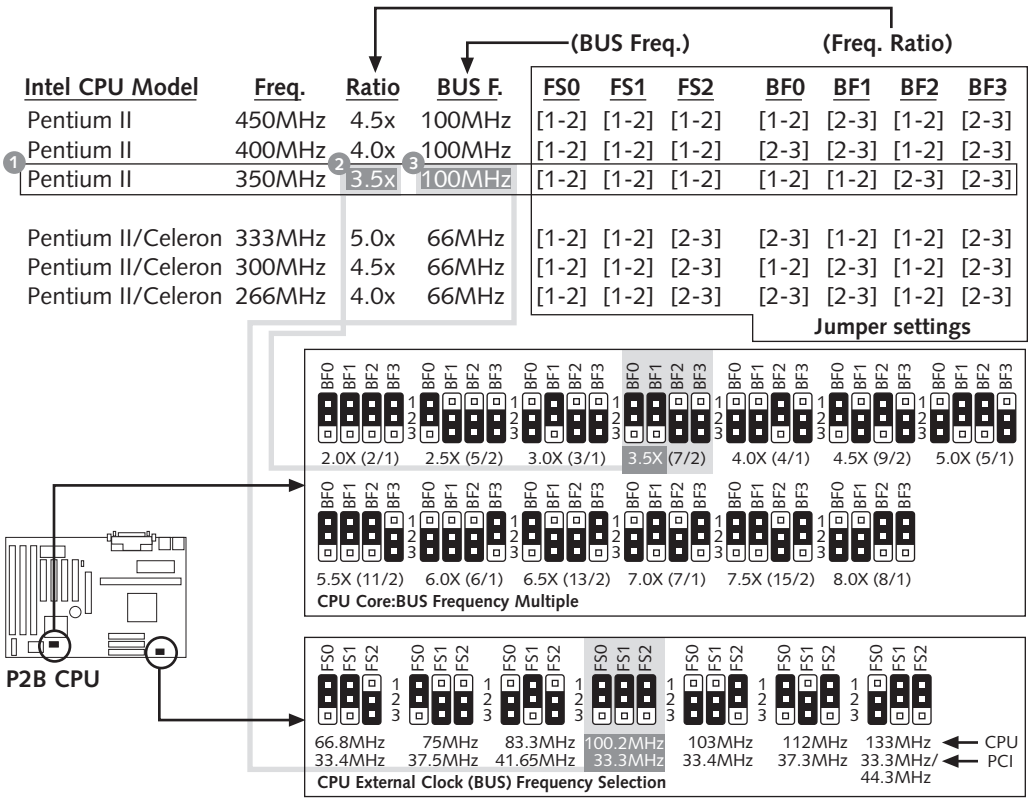

Figure 15-4 Based on the advertised speed of your CPU, select the multiplier and the bus frequency from the table, which then determines the jumper settings to use

Figure 15-5 shows the final settings for one of the jumper groups, the CPU core to memory bus speed ratio.

A+CORE 1.2, 1.8

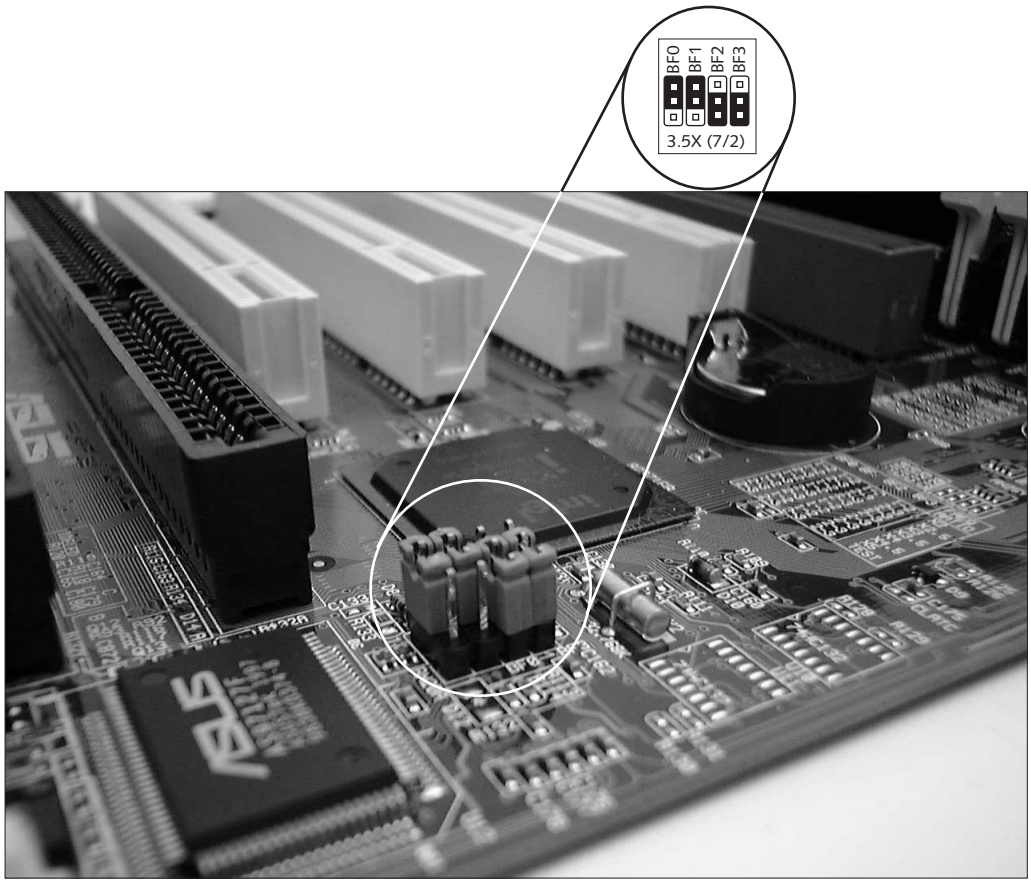

Figure 15-5 Jumper group that controls CPU core:bus frequency. Compare this photo to the diagram in Figure 15-4. The jumpers are set for the multiplier = 3.5.

Step 2: Install the CPU and CPU Fan

This system board has a Slot 1 for the Pentium II, which comes packaged either in a single edge contact cartridge (SECC) or a single edge processor package (SEPP) for the Celeron processor. For either processor, the system board uses a universal retention mechanism (URM), which is preinstalled on the board. Follow these steps to install the fan on the side of the processor first, and then install the processor on the system board.

- Unfold the URM arms. Flip both arms up until they lock into position (Figure 15-6).
- Examine the fan and processor to see how the fan brace lines up with holes in the side of the SECC (see Figure 15-7). Place the fan directly on the side of the SECC. The two should fit tightly together, with absolutely no space between them.

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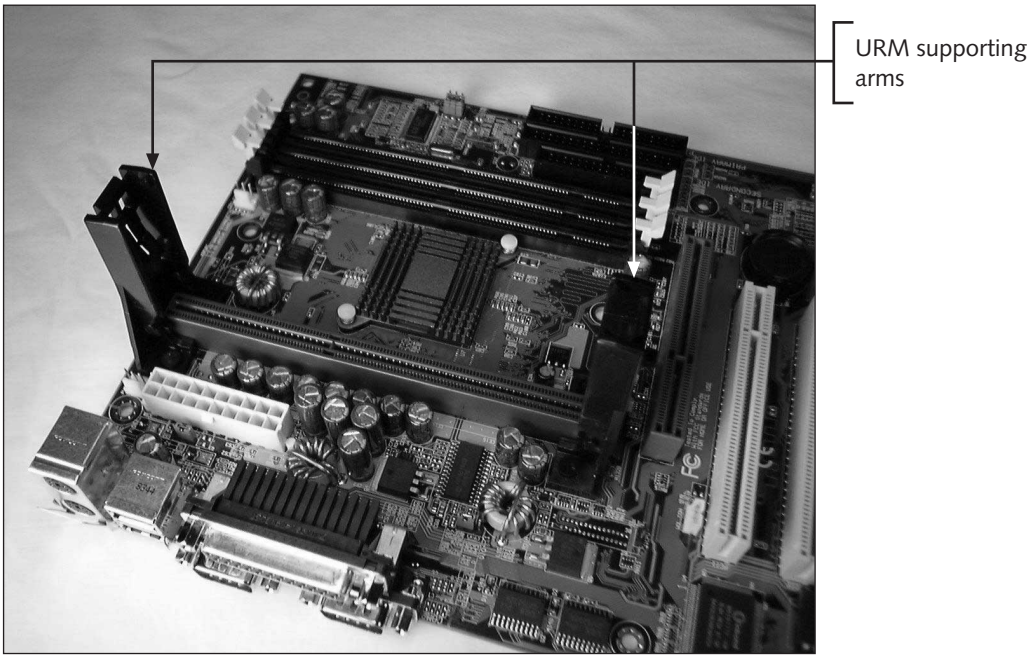

Figure 15-6 Preparing URM arms to receive the CPU. The arms are in the upright position.

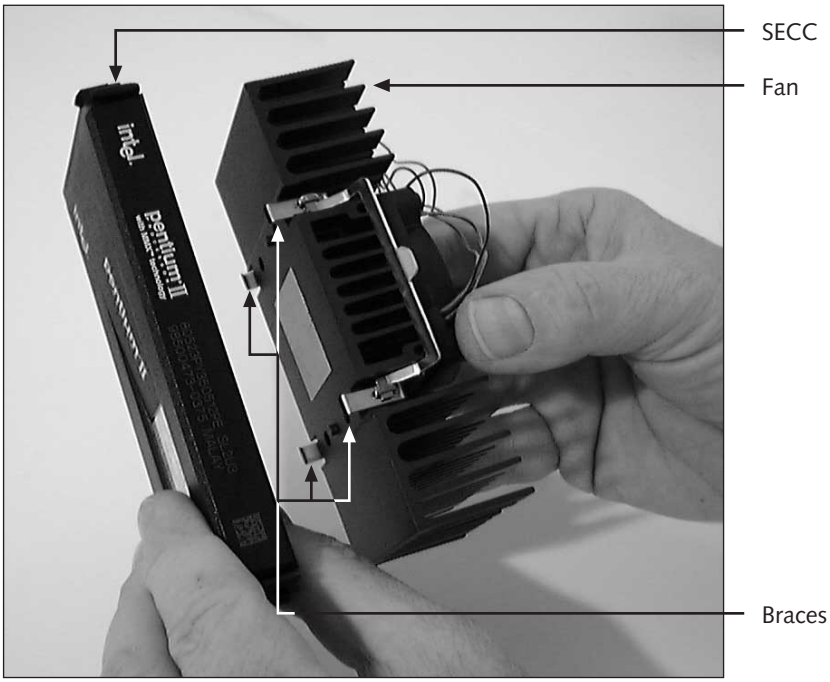

Figure 15-7 The braces on the fan align with holes in the side of the SECC

A+CORE 1.2, 1.8

- After the fan and SECC are fitted together, place the SECC on a table and push the clamp on the fan down and into place, to secure the fan to the SECC (see Figure 15-8).

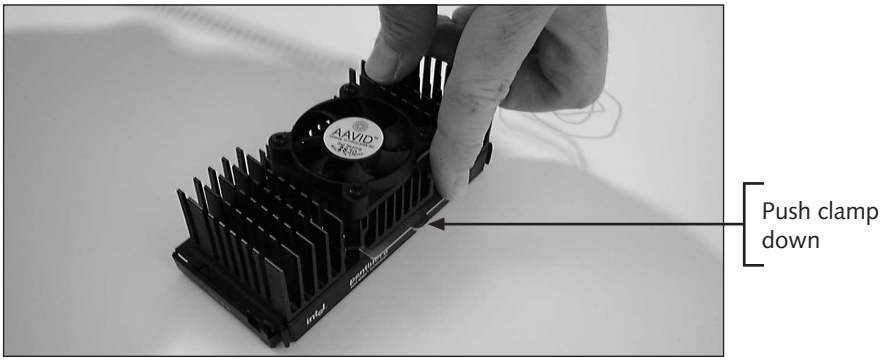

Figure 15-8 Push the clamp on the fan down until it locks in place, locking the fan to the SECC

- Insert the fan and SECC into the supporting arms (Figure 15-9). The SECC should fit snugly into Slot 1, similarly to the way an expansion card settles down into an expansion slot. The arms should snap into position when the SECC is fully seated. Be certain you have a good fit here.

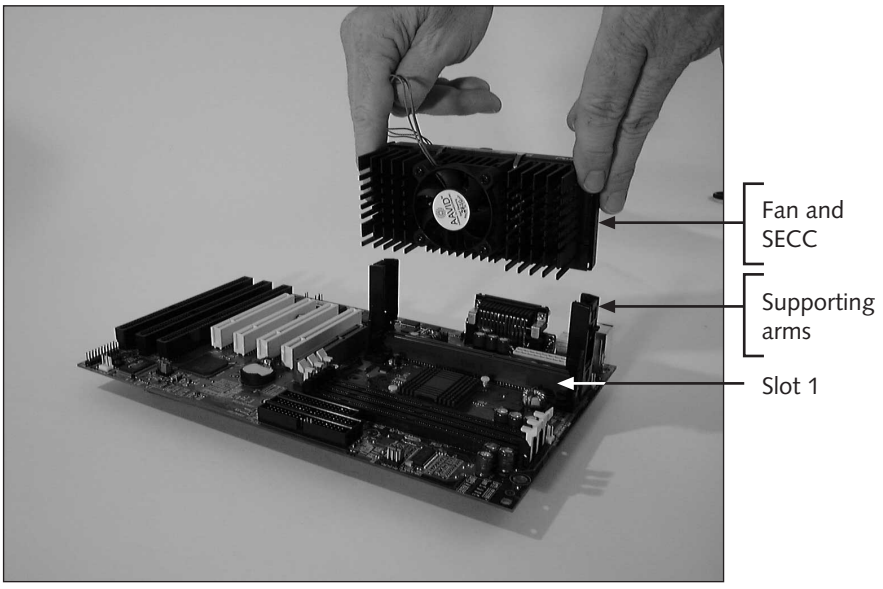

Figure 15-9 Insert the fan and SECC into the supporting arms and Slot 1

A+CORE 1.2, 1.8

- Lock the SECC into position by pulling the SECC locks outward until they lock into the supporting arm lock holes. See Figure 15-10. (Incidentally, this figure shows a good view of the ports coming off the system board, which are labeled in the photo.)

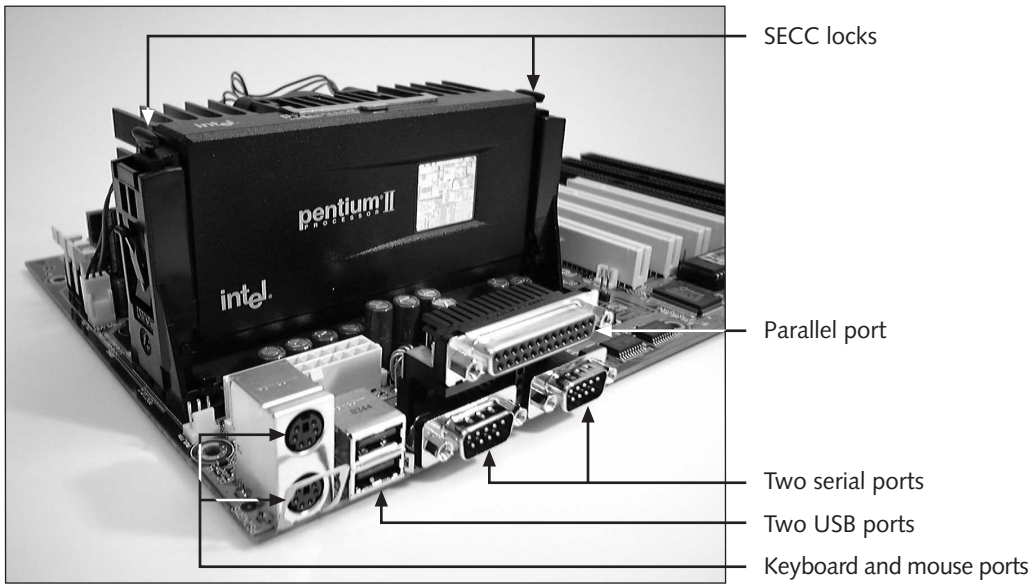

Figure 15-10 Push the SECC locks outward until they lock into the supporting arm lock holes

- Connect the power cord coming from the fan to the power connection on the system board (Figure 15-11). Look for the power connection near Slot 1. If you have trouble locating it, see the system-board documentation.

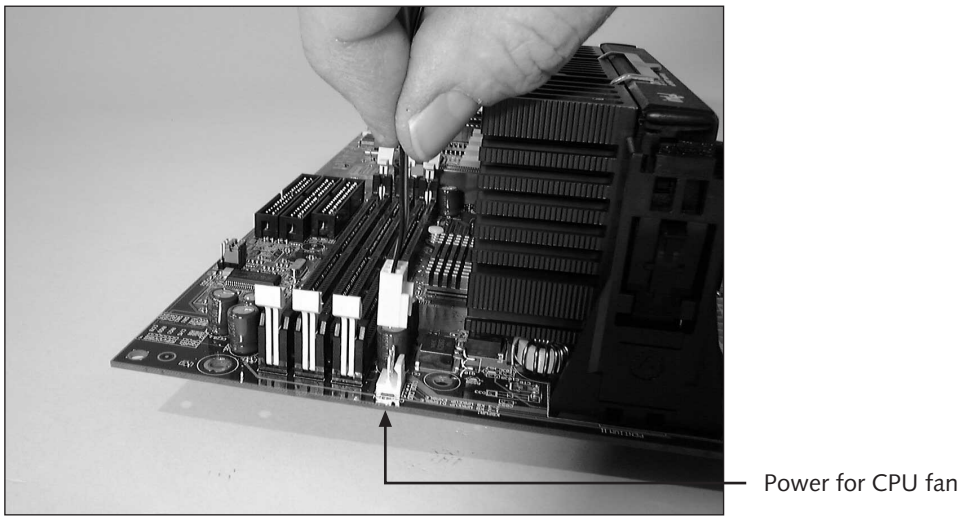

Figure 15-11 Connect the fan power cord to system board

Step 3: Installing RAM on the System Board

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From discussions in Chapter 4, you know how to select the right kind of RAM and the right amount for your system board, and you know that you should be careful to match size, manufacturer, production batch, and mode.

Our system board has three DIMM sockets, and each socket can hold DIMMs that contain either 8, 16, 32, 64, 128, or 256 MB of memory. Therefore, the amount of memory installed on this board can range from a minimum of one DIMM with 8 MB to a maximum of three DIMMs each having 256 MB, for a total of 768 MB. In our example, we are installing a single 64-MB SDRAM DIMM that is PC100-compliant, meaning that it is rated to work at the memory bus speed of 100 MHz.

As shown in Figure 15-12, insert the DIMM into DIMM Slot 1 (the DIMM slots are labeled 1, 2, and 3), following these directions:

- Pull the supporting arms on the sides of the slot outward.
- Look on the DIMM edge connector for the notches, which will help orient the DIMM correctly over the slot.
- Insert the DIMM straight down into the slot.
- When the DIMM is fully inserted, the supporting arms should pop back into place.

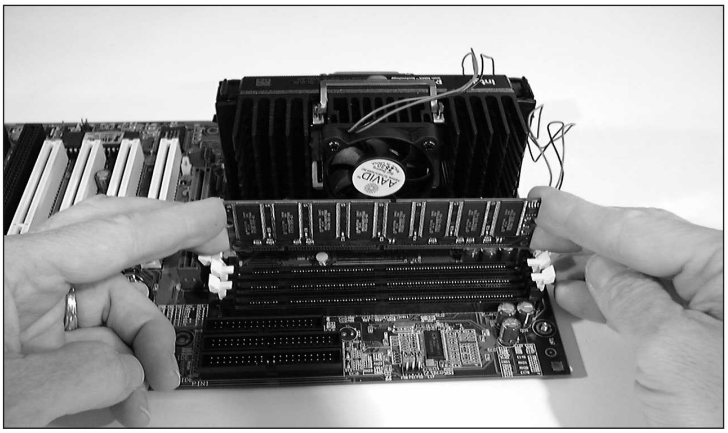

Figure 15-12 Insert the DIMM into the slot by pressing straight down until the supporting arms lock into position

Figure 15-13 shows the DIMM installed.

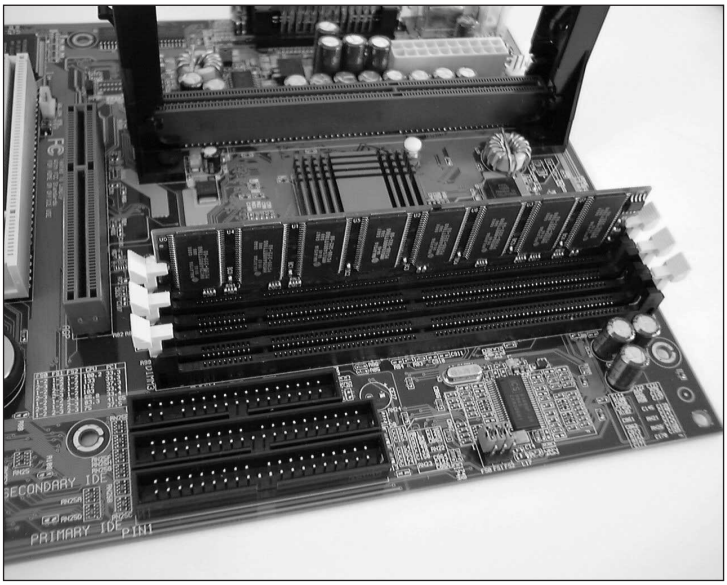

Figure 15-13 One DIMM installed in DIMM Slot 1. Can you look at the DIMM and tell if it is ECC-compliant?

Step 4: Verify That the System Board Is Working by Performing a Memory Test

Before we get too far along in the details of installation, do a quick verification that the critical components are working. To do this test, connect the video card and connect power to the system board, plug in the monitor, and turn on the PC and the monitor. You should get a good memory test (before the first error occurs, saying that BIOS cannot find a boot device). By getting a good memory test, you know that the BIOS, RAM, CPU, most of the system board, and video are all working. If any one of these components fails, there is no point in continuing the installation until the problem is located or the part replaced.

Caution is in order here because some power supplies cannot handle this test. Less expensive power supplies will not work or might even be damaged if they are turned on without a full power load applied. For these power supplies, a full load must include a hard drive or a similar device that will draw +12V. If you are using a very inexpensive power supply, skip this memory test and proceed to Step 5.

The system board is very vulnerable during this test, so you want to be careful, especially when the power is on. Set the system board on an antistatic mat as you work. Because the port side of the video card will protrude down below the system board when it is fully inserted in the expansion slot, the system board must be sitting higher than the table surface. (For our memory test, we set the system board on top of its shipping box with an antistatic mat under it.) When the power is on, don't touch the system board, the video card, or any system-board components.

Installing the Video Card

The next step for your test is to temporarily install the video card on the system board. Proceed as follows:

As in Figure 15-14, place the video card into position. When seating a card, push the card directly down into the expansion slot, as the photo illustrates.

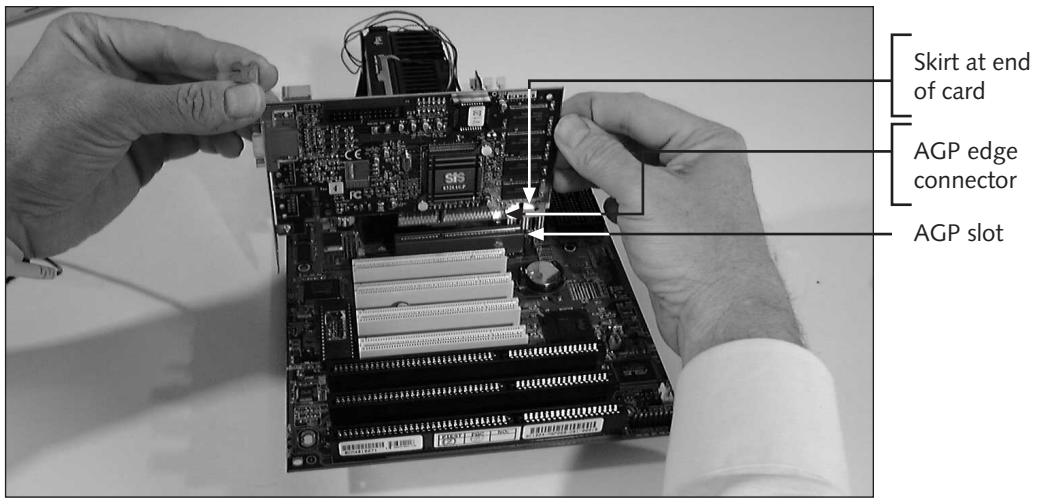

Figure 15-14 Insert the video card in the AGP slot

An expansion card inserted into a system board that is not already installed in a case is vulnerable to damage. Be careful that you don't move the system board much once the card is installed, so that the card is not bent as the system board is moved about.

Powering Up and Watching for the POST Memory Test

In this next step, we connect the system board to the power supply and to the monitor, and perform POST in order to verify that critical parts are working.

- Set the system board near enough to the computer case so that the power cords can reach the power connections on the system board.
- Connect the power cord, which will only go into the P1 power connector in one direction (Figure 15-15).

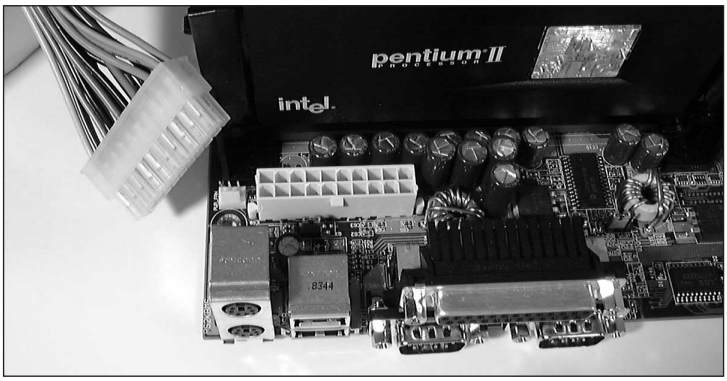

Figure 15-15 Connect the power cord to the system board

- This ATX power supply requires that the ATX power switch be connected to the system board. The switch wire comes from the front of the case and connects to the system board at the panel connections (Item 10 in Figure 15-2). Connect the switch wire to the panel connection, as seen in Figure 15-16. (An AT power supply does not have this switch wire.)

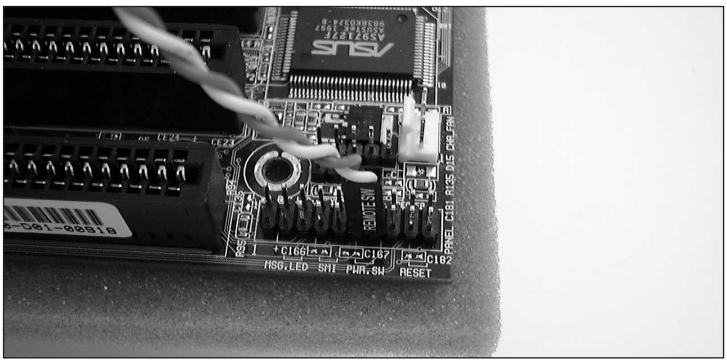

Figure 15-16 Connect the ATX power switch to the system board in preparation for the memory test

- Plug the video cable into the video port of the video card. Figure 15-17 shows all connections to the system board ready for the test.
- Connect the power cords from the case and monitor to a wall outlet or surge suppressor.
- Before turning on the power, check again that all connections are secure, unused power cords are tucked safely out of harm's way, and the system-board components are not touching anything metallic or conductive that would ground them or cause a short.
- Turn on the monitor and the PC and watch startup BIOS perform POST (see Figure 15-18).

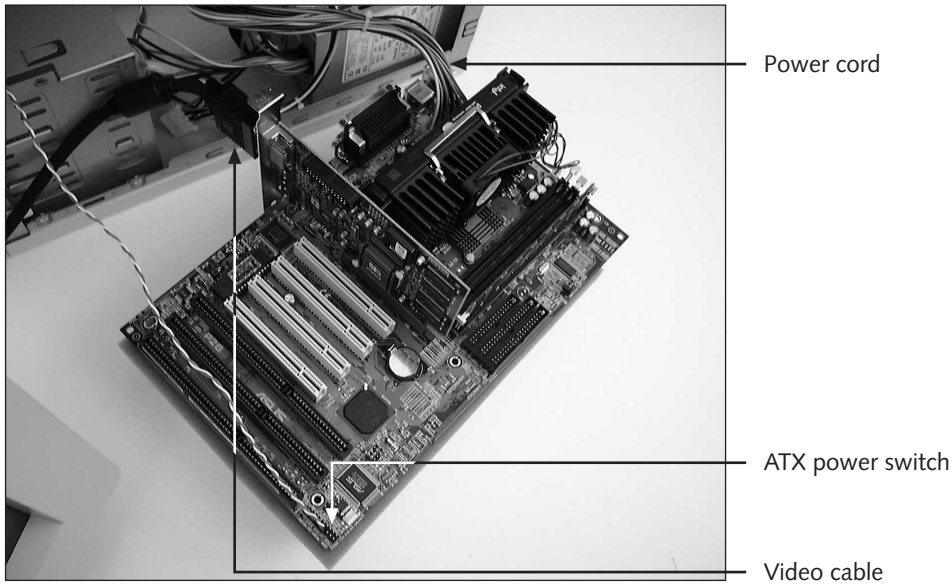

Figure 15-17 All connections to the system board are ready for the memory test

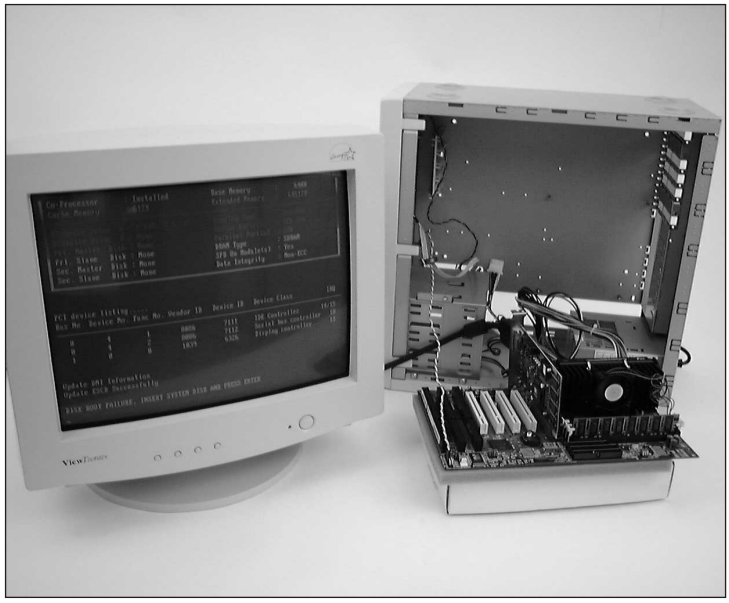

Figure 15-18 Memory test is successful

- Look for POST to count up a full 64 MB of RAM on the monitor screen. Also look for POST to display the speed of the CPU and confirm that the speed is correct in order to verify your jumper settings on the system board. Next, POST

looks for hard drives and finds none, and then gives an error message when it also cannot detect a floppy drive or keyboard. This is all to be expected; however, the memory test does prove that the critical components of the system already installed are working, and that you can continue with the installation.

- Turn the computer and monitor off, remove the video card, and disconnect the power cords (including the power cord from the power supply to the system board) before continuing the installation.

Step 5: Installing the System Board in the Computer Case

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Installing the system board in the computer case may take more patience than installing other components. The case comes with the necessary spacers and screws, and most system boards align well with most cases. However, sometimes the holes are difficult to align, and screws and spacers difficult to install. Some system boards use a small faceplate that is installed between the system-board ports and the case, which creates a well-fitted enclosure around the ports. First, install the faceplate at the rear of the case and then install the standoffs. A **standoff** (or spacer) is a small plastic or metal peg that separates the system board from the case and holds the system board in place. Standoffs are necessary so that components on the bottom of the system board don't touch the case, which can cause a short on the system board.

Select the correct faceplate for the rear of the case and install it:

- This system board comes with three faceplates to cover the ports that come directly off the system board. Select the one faceplate that fits the ports for this system board (see Figure 15-19). The other faceplates can then be discarded.

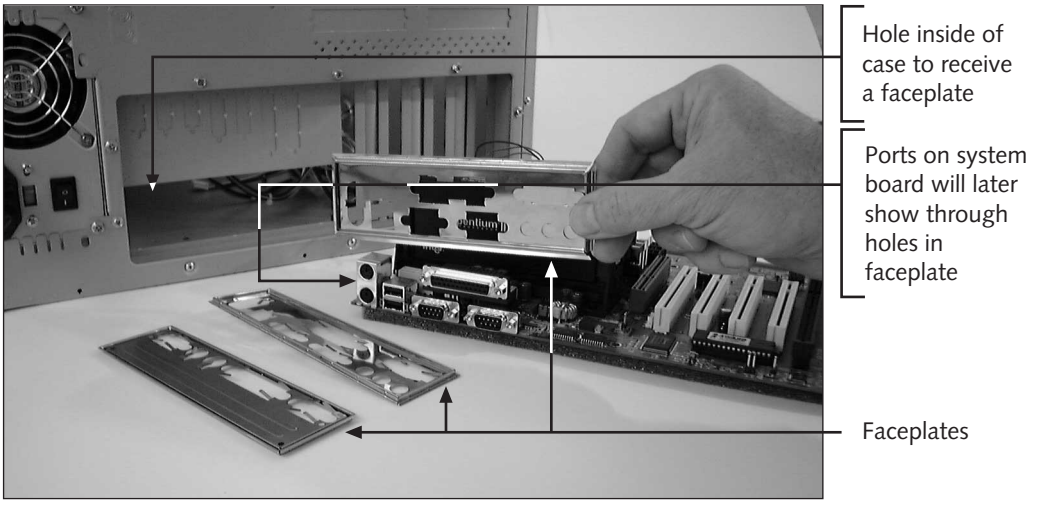

Figure 15-19 The computer case comes with several faceplates. Select the faceplate that fits over the ports that come off the system board. The other plates can be discarded.

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- Insert the faceplate in the hole at the back of the case (see Figure 15-20).

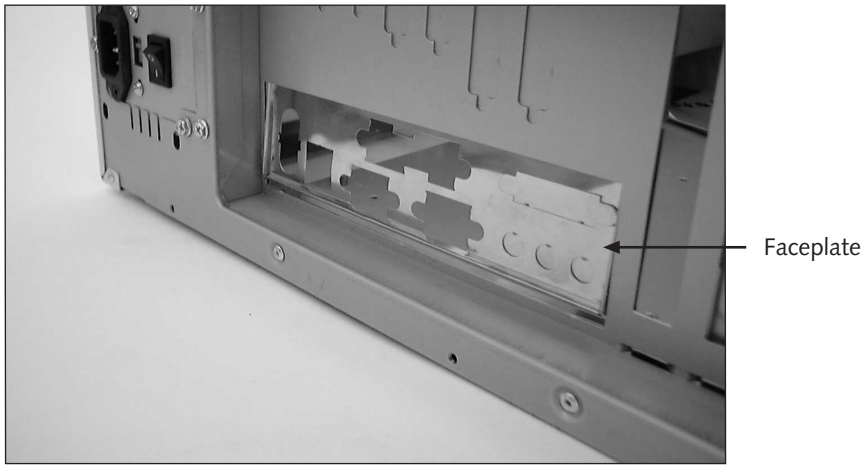

Figure 15-20 Install the faceplate in the hole at the rear of the computer case

The next step is to select the holes for the standoffs, install the standoffs, place the system board in the case, and use screws to hold it in place.

- To determine in which holes to use the standoffs, align the system board with the case and consider the position of the board in the case. To help orient the board to the case, align the ports coming off the system board to the faceplate just installed. Because a case is designed to fit more than one type of system board, there will be unused screw holes on the case. If you cannot locate a screw hole on the case, try tipping the case on its end so that you can see the bottom, where the holes are.
- Screw the standoffs into the slots on the bottom of the case. Figure 15-21 shows how the standoff is positioned correctly so that when the system board is moved into position the standoff will line up directly underneath the hole in the system board where a screw will be inserted into the standoff.
- Use as many standoffs as there are aligned holes in the system board and in the case. With this case and board, six standoffs can be used, but don't settle for fewer than four.
- If you need to remove a standoff to move it to a new slot, needle-nose pliers work well to unscrew the standoff so that you can move it to a new hole.
- After the standoffs have been installed in the case, place the system board inside the case and use screws to attach the system board to the case, using the standoffs to receive the screws. Figure 15-22 shows the system board sitting in the computer case. Three standoffs and four screw holes are visible where the board must be moved slightly left and down in order to align the holes over the standoffs.

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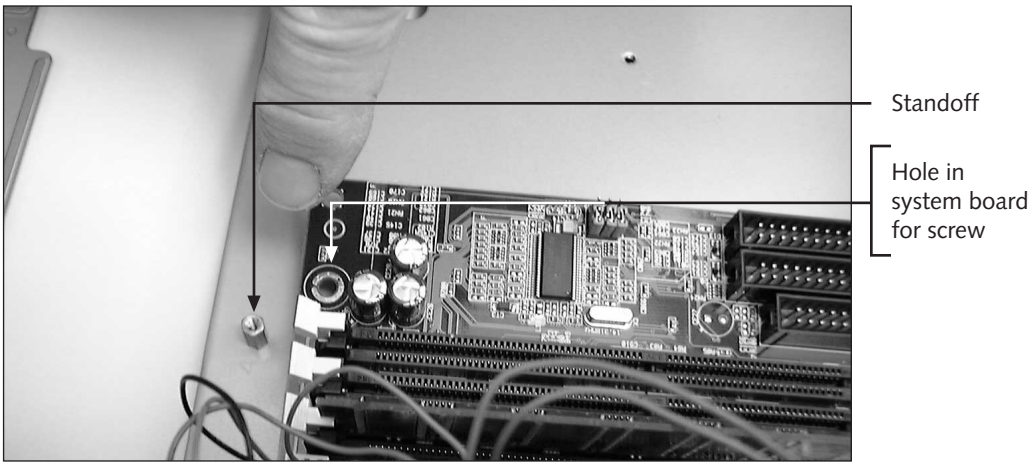

Figure 15-21 Select the positions of each standoff so that holes in the system board will align directly over the standoff. The system board will later be held in place with screws in the standoffs.

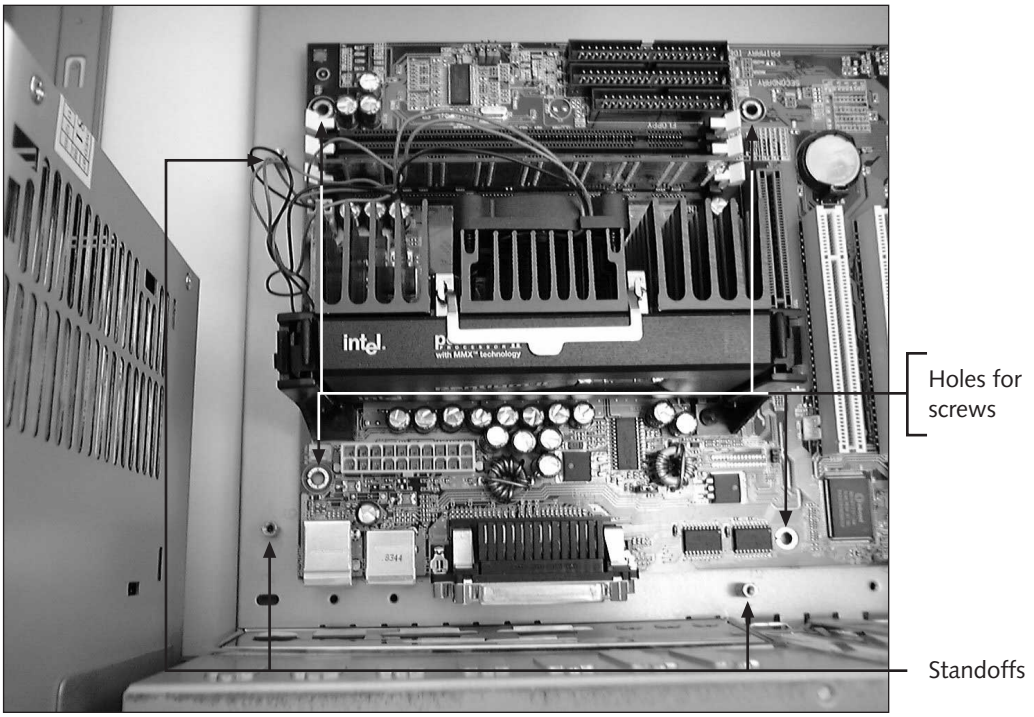

Figure 15-22 Three standoffs and four screw holes are visible

Step 6: Attaching the Power Cord and Front Panel Connectors to the System Board

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Connect the power cord to the P1 power connection on the system board. The cord can only connect in one direction. (Recall that for an AT system board there are two power connections, P8 and P9, which are connected using the black-to-black rule.)

On the front panel of the computer case are several lights and one switch, and the speaker is nearby. The switches are inputs to the system board, while the lights and speaker are outputs from the system board, which are all connected to the system board by wires. The case comes with these wires permanently attached, but the leads on the ends of each wire must be connected to pins on the system board. The next step to complete the installation of the system board is to connect the wire leads from the front panel of the case to the system board. You can see the front panel connectors as Item 10 in the diagram in Figure 15-2. A close-up of these pins with the one power switch wire attached is shown in Figure 15-16, and the purpose of each connection is labeled in Figure 15-23. The wires coming from the front panel of the case are also labeled in Figure 15-24.

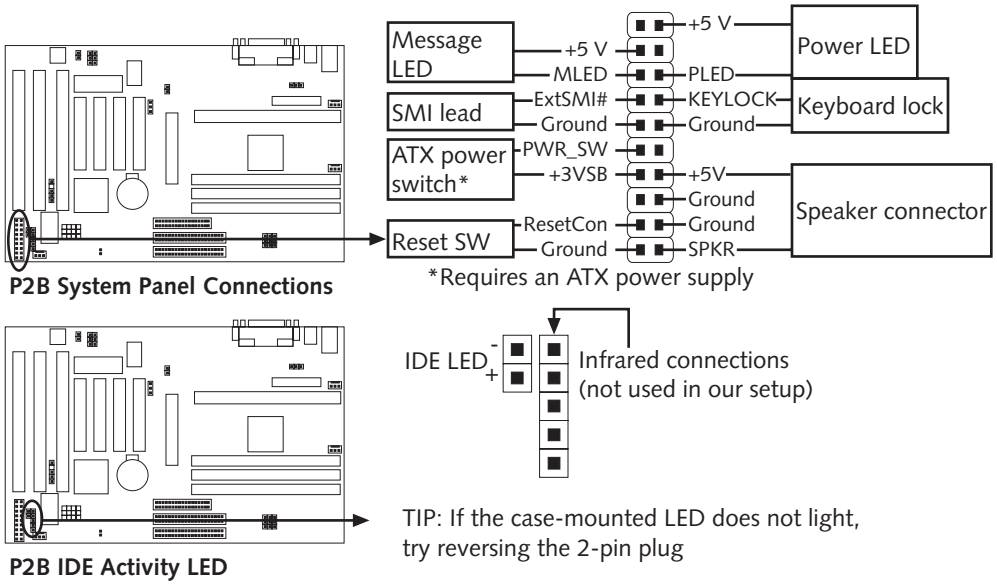

Figure 15-23 Panel connections on the system board

There are five wires coming from the front panel. The five connectors are:

- **Reset switch.** Used to reboot the computer
- **HDD LED.** Controls a light on the front panel that lights up when any IDE device is in use. (LED stands for light-emitting diode; an LED is a light on the front panel.)
- **Speaker.** Controls the speaker

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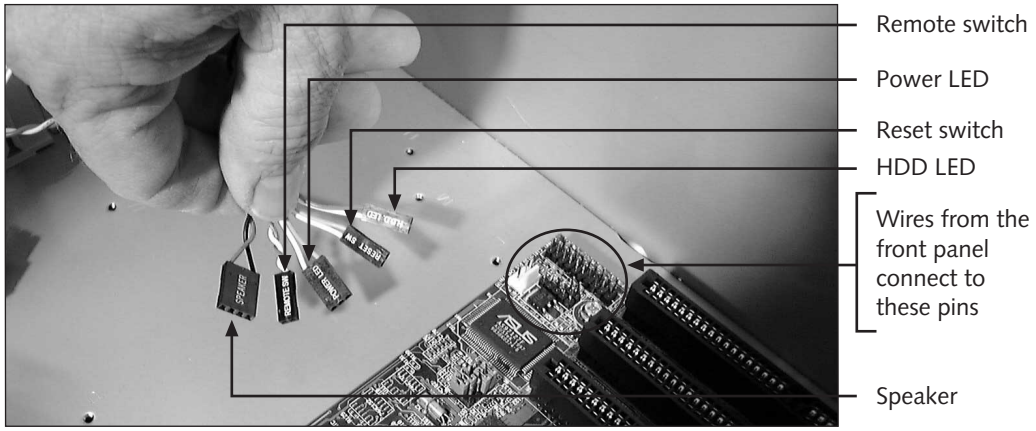

Figure 15-24 Five wires from the front panel connect to the system board

- **Power LED.** Light indicating that power is on
- **Remote switch.** Controls power to the system board; must be connected for the PC to power up

Because the computer case and the system board were not made by the same manufacturer, the labels on the connectors are not the same as the labels on the system board or in the documentation for the system board. A little experience will quickly help you make the translation, but it's okay to guess when connecting a wire to a connection. If it doesn't work, no harm is done.

The connectors are really pins. A lead wire from the front panel may have pin holes for two, three, or four pins. The speaker uses a 4-pin connector, and the power LED uses a 3-pin connector. The reset switch, HDD LED, and remote switch all use 2-pin connectors. A 3-pin connector similar to the power LED is shown in Figure 15-25.

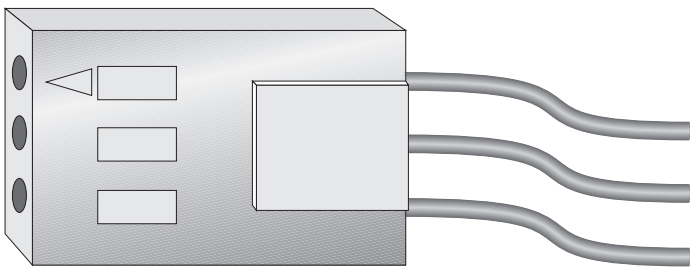

Figure 15-25 Look for the small triangle embedded on the wire lead connectors to correctly orient the connector to the system-board connector pins

To help orient the connector on the system-board pins, look for a small triangle embedded on the connector that marks one of the outside wires as pin 1. Sometimes the documentation will mark pin 1 as a square pin in the diagram, rather than round like the other pins.

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Also, the wires coming from the connector are color-coded, although the coding scheme for the wires is often not included in the computer case documentation. Some connectors have the name of the lead printed or embedded on the connector; the case we use does have that. But if the purpose of the wire is not written on the connector to show which wire lead goes to which connector on the system board, you must trace the wire back to its source on the front panel. You might need to do a little guessing until you get the right lead wires connected to the right location on the system board. Sometimes you will not know if your guess is right until you power up and check out the reset button and LED lights on the front of the case. In general, proceed as follows:

- If the purpose of the wire lead is not written on the wire connector, then trace it back to its source on the front of the computer case to determine which lead belongs where.
- Orient the lead to the pins by looking for the triangle on the lead connection and orienting it according to the documentation. Or try orienting the connector to the pins by using the color of the wire.
- If neither method of orientation works, then guess. Later, if one of the wires does not work, reverse the connector. For example, later, when the PC is up and working but the hard drive light does not come on, reverse the HDD LED connector on the pins.

For this installation, using the documentation in Figure 15-23, we see that the five wires in Figure 15-24 fit the pins in the right corner of the system board this way:

- Reset switch wire in Figure 15-24 matches "Reset SW" in Figure 15-23
- HDD LED wire in Figure 15-24 matches "IDE LED" in Figure 15-23
- Speaker wire in Figure 15-24 matches "Speaker connector" in Figure 15-23
- Power LED wire in Figure 15-24 matches "Power LED" in Figure 15-23
- Remote switch wire in Figure 15-24 matches "ATX Power Switch" in Figure 15-23

If the ATX Power Switch is not connected correctly, later when the PC is turned on, it will appear "dead." There will be no video, no beeps, no lights.

Step 7: Installing the Floppy Drive, Hard Drive, and Zip Drive

Installing the floppy drive is generally easy to do, but the other three drives (hard drive, Zip drive, and DVD drive) require a little planning because they are all IDE devices. However, we cover the floppy drive, hard drive, and Zip drive as a group here because they all fit together into a removable bay. The DVD drive will be covered later as part of the complete DVD subsystem.

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Set IDE Jumpers on Each IDE Drive in the System

Before we get into the details of installing the drives, let's quickly review IDE installations previously covered in Chapter 7. Recall that there can be up to two IDE controllers on a system board, the primary and secondary IDE controller. Each controller can support up to two drives, a master and a slave, for a total of up to four IDE drives in a system. When possible, leave the hard drive as the single drive on one controller so that it does not compete with another drive for access to the controller and possibly slow down performance. Recall that each IDE drive must be configured as single, master, or slave. Configuration is normally done by setting jumpers on the drive housing, and the explanation of the jumper settings is most often printed somewhere on the housing.

In our installation, we will set the hard drive as the single drive on the primary controller, and the Zip drive will be set to master and the DVD drive to slave on the secondary controller. Figure 15-26 shows the back of the Zip drive. There is a group of three jumpers, and printed on the top of the drive is an explanation of each setting. The rightmost pins in the group are closed in the photo, which is the setting for master. This drive is typical of most IDE drives in that there are a 40-pin IDE data connection, jumpers, and a power connection on the backside of the drive.

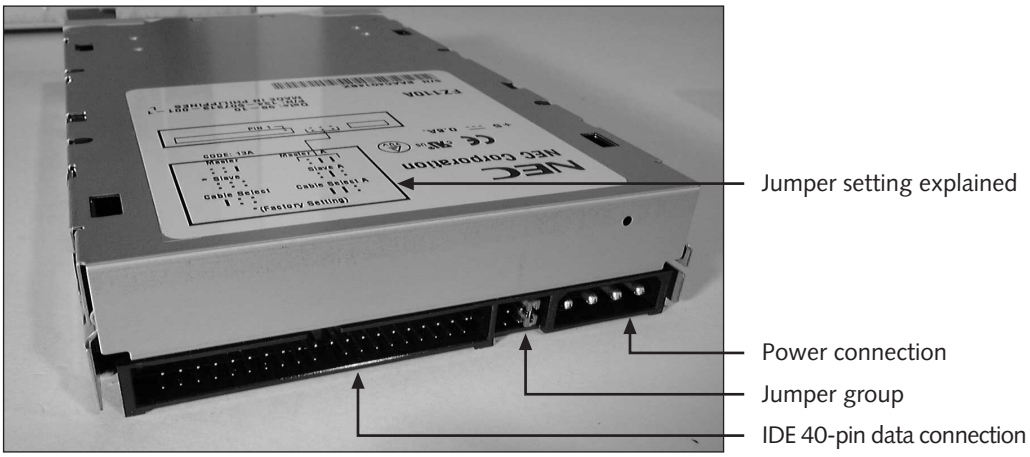

Figure 15-26 Jumpers on the Zip drive housing are used to configure an IDE drive as single, master, or slave

In a similar fashion, the hard drive jumpers are set to a single IDE drive, and the DVD drive jumpers are set to slave. Later, when we connect data cables to the drives, the hard drive will have its own data cable, and the Zip drive and DVD drive will share a cable.

Installing Drives in the Removable Bay

There are two bays in this computer case (Figure 15-27). The top bay is designed for large drives, such as a DVD or CD-ROM drive, and is not removable. The lower bay is narrow, designed for small drives, such as floppy drives and hard drives, and is removable. This bay has

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room for three drives; the top two positions are accessible from the front of the case and will be used for the floppy drive and Zip drive, while the lower position, which is not accessible from the front of the case, will be used for the hard drive. When installing drives, be sure to use short screws that will not protrude too deeply into the drive and damage it. Follow these steps to install the three small drives in the lower bay:

- Place the floppy drive in the bay and align the drive flush with the front of the computer case (Figure 15-27), noting where the screw holes in the drive align with the side of the bay.

Figure 15-27 Line up the floppy drive in the removable bay, flush with the front of the case

- Remove the bay and secure the floppy drive to the bay with four screws, two on each side of the bay (Figure 15-28).
- Install the Zip drive underneath the floppy drive; align it flush with the floppy drive, and secure it with four screws.
- Install the hard drive in the last position (Figure 15-29). Position the hard drive flush with the end of the bay so that it will butt up against the computer case once the bay is in position.

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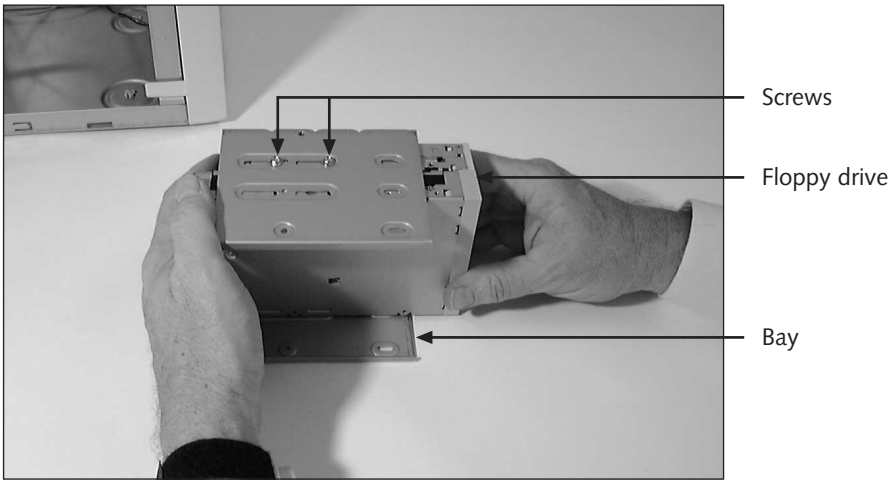

Figure 15-28 Secure the floppy drive to the removable bay with four screws, two on each side of the bay

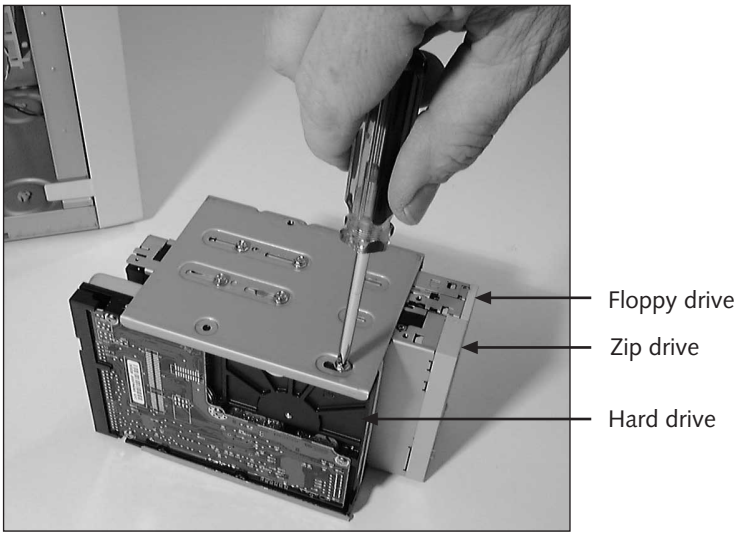

Figure 15-29 Position the hard drive flush with the end of the bay

- Next, install the data cables to each drive (Figure 15-30). The floppy drive has its own cable. Install the end of the cable with the twist so this drive will be drive A in the final configuration. Look on the drive for a small 1 that indicates pin 1 and align that with the colored edge of the data cable. (In most cases, pin 1 is next to the power connection on a floppy drive and oriented in the opposite direction from that of IDE drives.)

A+CORE 1.2

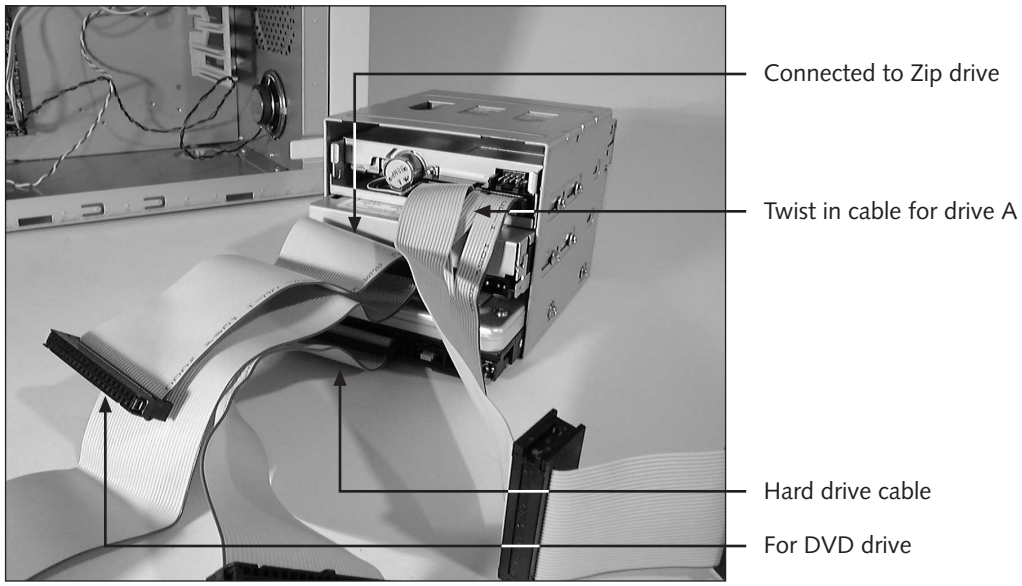

Figure 15-30 Connect the cables to all three drives

- Connect the first IDE cable to the hard drive and the second IDE cable to the Zip drive. Make sure the pin 1 label on the drive housings is aligned with the colored edge of the data cables.
- Plan for the second IDE data cable connected to the Zip drive to also connect to the DVD drive, which will later be installed just above it.
- Place the bay back into position and secure the bay with the bay screw (Figure 15-31).

A+CORE 1.2

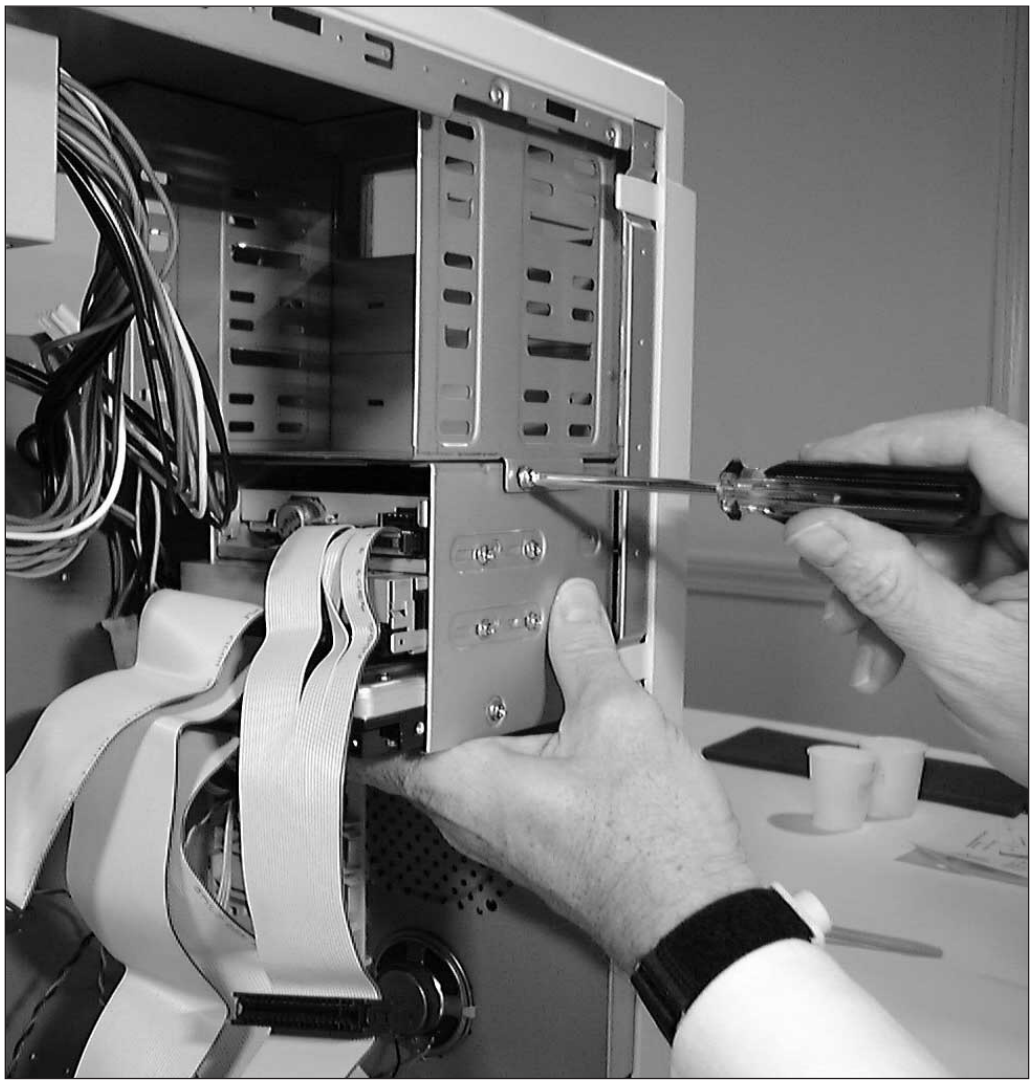

Figure 15-31 Secure the bay with the bay screw

- Install a power connection to each drive (Figure 15-32). The floppy drive will use the small power connection, and the other drives use the larger ones. It doesn't matter which of the power cords you use, because they all produce the same voltage.
- Connect the floppy drive data cable to the floppy drive connection on the system board, the hard drive data cable to the primary IDE connection, and the Zip drive data cable to the secondary IDE connection on the system board (see Figure 15-33). For each cable, look for pin 1 labeled on the system board and align it with the colored edge of the data cable.

A+CORE 1.2

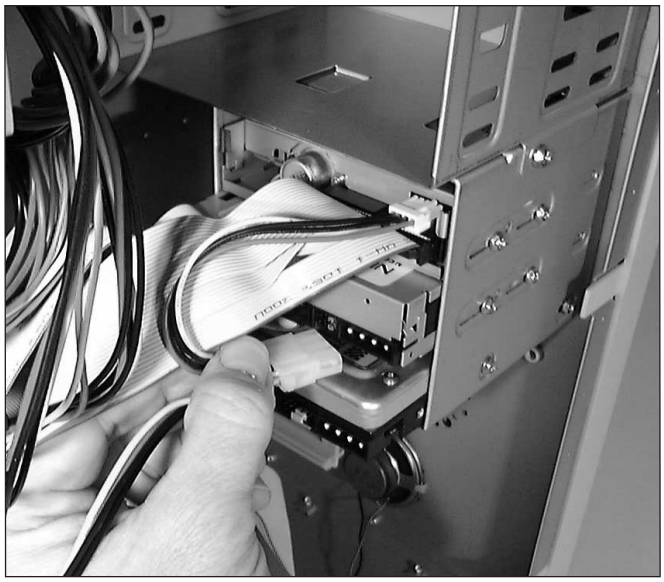

Figure 15-32 Connect a power cord to each drive

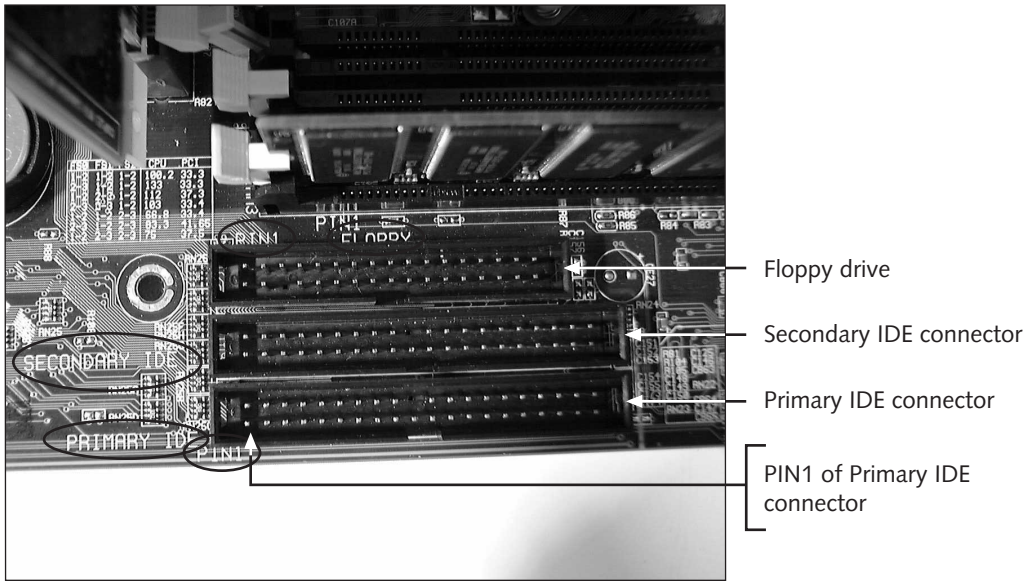

Figure 15-33 Floppy drive and two IDE connectors on the system board

Step 8: Installing the Video Card, Sound Card, Modem Card, and SCSI Adapter

The next step is to install the expansion cards, including the video, sound, modem, and SCSI cards. In general, when installing an expansion card, first read the documentation for the card and set any jumper switches or DIP switches on the card. (Most cards today are Plug and Play and have no jumpers.) Next, select the expansion slot you plan to use on the system board, remove the faceplate for the selected slot from the computer case, and insert the card in the slot. When inserting a card in an expansion slot, press the card straight down into the slot. As you insert the card, don't allow the card to wobble in the slot, because that could widen the slot and prevent a tight fit. Make sure the card is inserted solidly in the slot and then, using the same screw that held the faceplate in position, screw the card to the computer case.

Follow these directions to install the four expansion cards:

Installing the Video Card

The video card has no jumpers to set and goes into the single AGP slot on the system board, so installation is straightforward. Remove the faceplate from the opening on the back of the computer case for this slot. Insert the card in the slot and secure it with a screw (Figure 15-34). That's it.

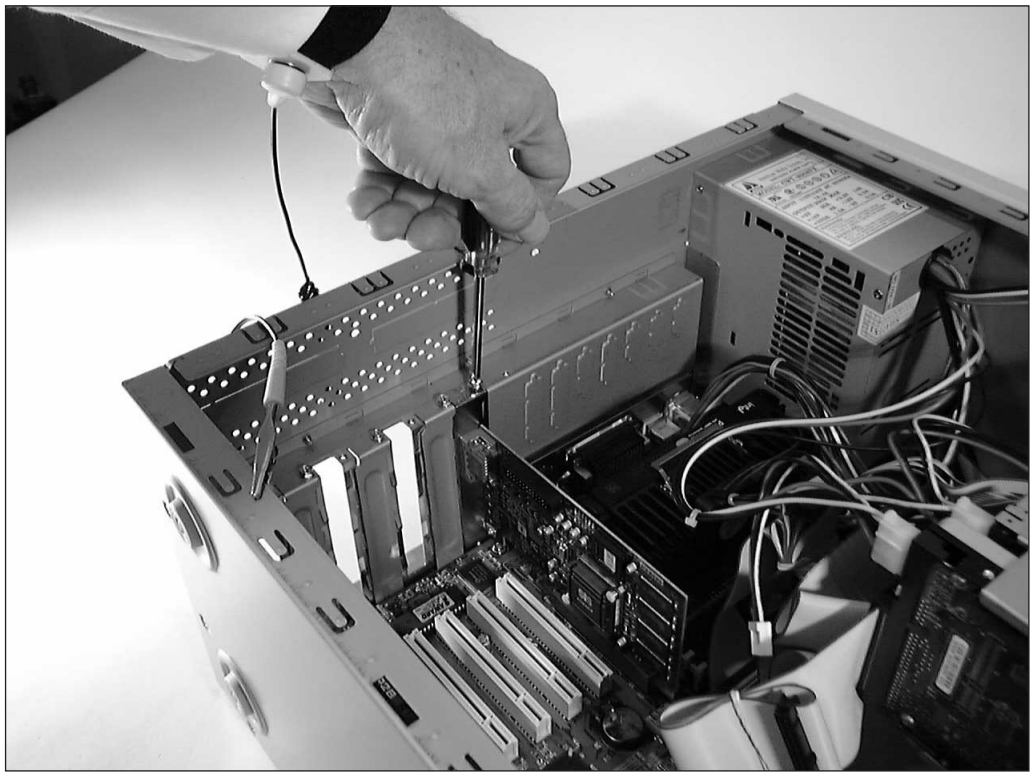

Figure 15-34 Secure the video card in the slot with a screw

Installing the Sound Card

The Sound Blaster sound card shown in Figure 15-35 has three internal connections (connections to something inside the case) and one jumper group that enables or disables a speaker amplifier.

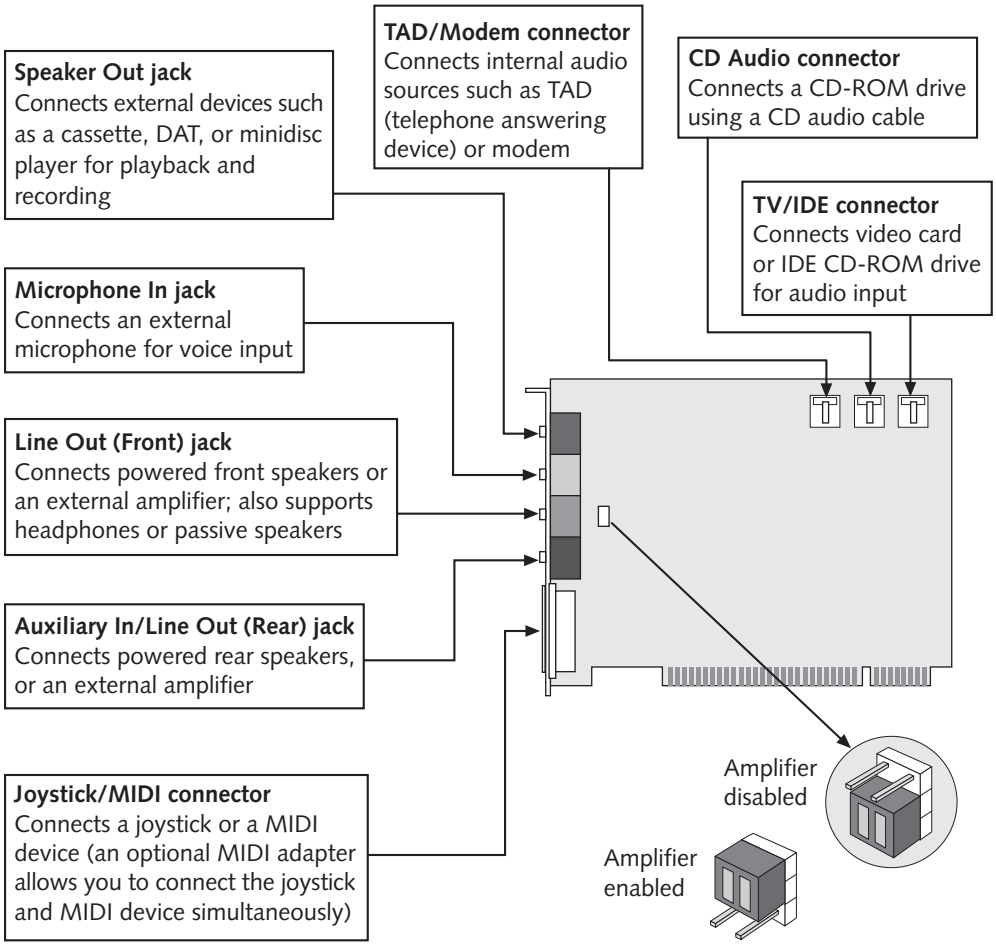

Figure 15-35 The Sound Blaster sound card has three internal connections and one jumper group that controls amplifier support

In a system using a CD-ROM drive, an audio cord would run from the CD-ROM drive to the CD audio connector (center connector in the group of three) to receive audio input directly from the CD-ROM. However, in our installation, we're using a DVD drive, which reads CDs as well as DVDs. The DVD drive requires a DVD decoder card to decode the audio and video data, so the setup will be slightly different from one that has a CD-ROM drive, which does not require a decoder card. There will be an audio cord that will transmit audio directly from the DVD drive to the DVD decoder. The decoder card will decode the audio data, and then another

audio cord will send the decoded data from the DVD decoder card to the sound card (more about this DVD installation later in the chapter). Since we will be using a speaker system with an amplifier, we want to disable the amplifier on the card. Therefore, proceed as follows:

- Set the jumper on the sound card to disable amplifier support (jumper cap in lower position).
- Connect the audio wire to the center connector labeled CD audio (Figure 15-36).

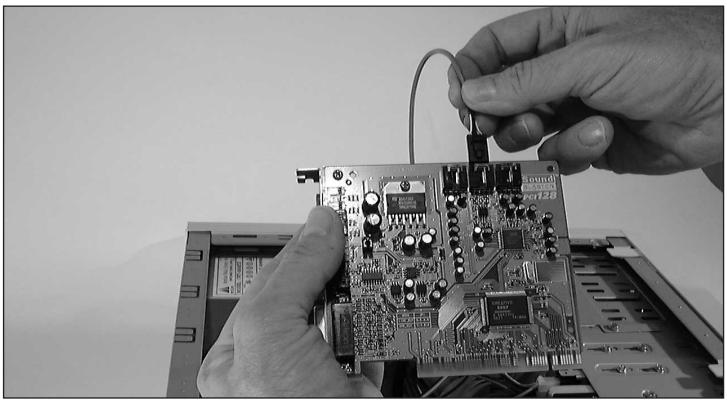

Figure 15-36 Connect the audio card to the sound card

- Remove the faceplate from an ISA slot and insert the card in the slot.
- Secure the card to the computer case with a screw.

Installing the Modem Card

The modem we're installing is the 3Com U.S. Robotics 56K Winmodem. It comes with a phone cord and two floppy disks. One disk contains the User Guide, and the other contains driver files. The modem is Plug-and-Play-compliant and uses an ISA slot. There are no jumpers or switches to set on the card, so the physical installation is simple. (If you are installing a modem card that is not Plug and Play, read the documentation to see how to set jumpers for the IRQ and I/O address that you will use for the card.) Select an ISA slot and remove its faceplate. Insert the modem card in the slot and secure the card with a screw.

Installing the SCSI Host Adapter

Next is the installation of an SCSI host adapter. The SCSI host adapter we use is shown in Figure 15-37 and supports only one single-ended SCSI device, as evidenced by the 25-pin port on the back of the card. (Remember that differential SCSI devices use a 50-pin connection.) The card is set to use SCSI ID 7 and (since it will always be on one end of the SCSI chain) to provide termination on the SCSI bus. Figure 15-38 shows a diagram of the card with the jumpers marked. The card is not Plug-and-Play-compliant, so there are several jumpers on the card, which collectively make up the card configuration, including the IRQ, I/O address, SCSI parity, and SCSI disconnection.

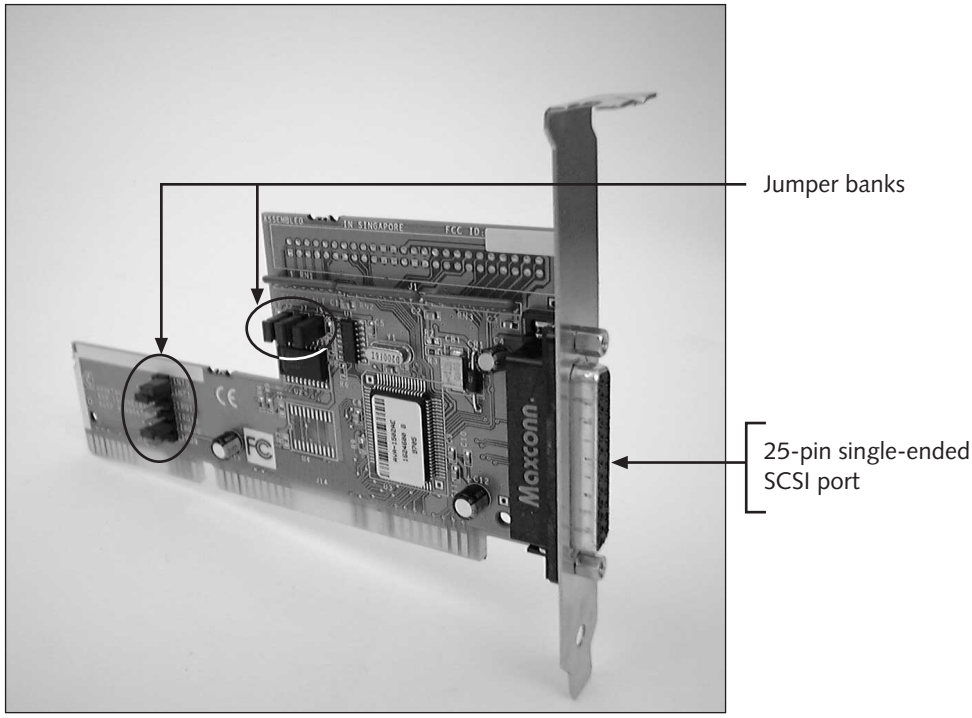

Figure 15-37 SCSI host adapter card

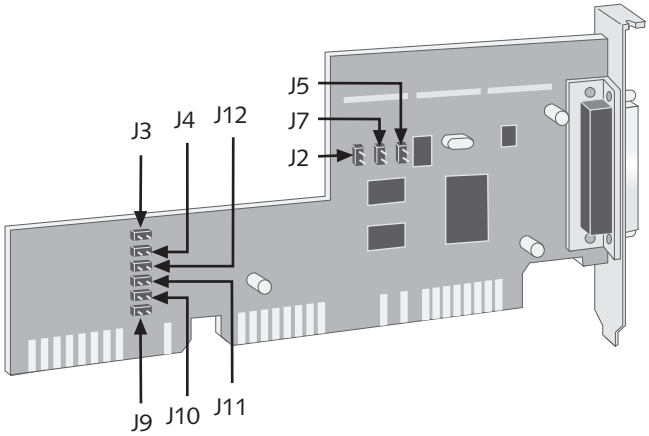

Figure 15-38 Diagram of the SCSI host adapter showing jumper positions on the card

Figure 15-39 shows a table of jumper settings similar to that in the card documentation. After reviewing our options, we choose the default settings, which are IRQ 10, I/O address 140h, SCSI parity enabled, and SCSI disconnection disabled. When you're installing any card, don't

forget to mark the selections you have made on the documentation. Later, if you want to know what settings have been chosen, you can look at the documentation rather than having to remove the case cover to see the card. Proceed as follows:

- Even though the jumpers should already be set to these settings according to the table in Figure 15-39, verify that they are set correctly on the card.

SCSI Disconnection	J2	I/O Port Address	J5	SCSI Parity	J7
Enabled Disabled*	Off On	140h* 340h	On Off	Enabled* Disabled	On Off

	IRQ Channel	J3	J4	J12	J11	J10	J9
On = Jumper Off = No Jumper	9 10* 11 12	On Off On Off	On On Off Off	Off Off Off On	Off Off On Off	Off On Off Off	On Off Off Off

Figure 15-39 Table of jumper settings for the host adapter

- Install the card in a 16-bit ISA expansion slot.

Step 9: Installing the DVD Subsystem

This multimedia PC includes a DVD drive. We're installing the Creative PC-DVD Encore by Creative Labs, Inc. Besides the documentation and a sample DVD game disc, the parts that are included in the DVD drive kit are shown in Figure 15-40. The data coming from the DVD drive is split into video data and sound data. Recall from Chapter 10 that video data must be decoded before output to the monitor, and sound data must be decoded before output to a regular sound card (one that does not process Dolby sound). Both are accomplished by the DVD decoder card. Figure 15-41 shows the flow of data in the completed system.

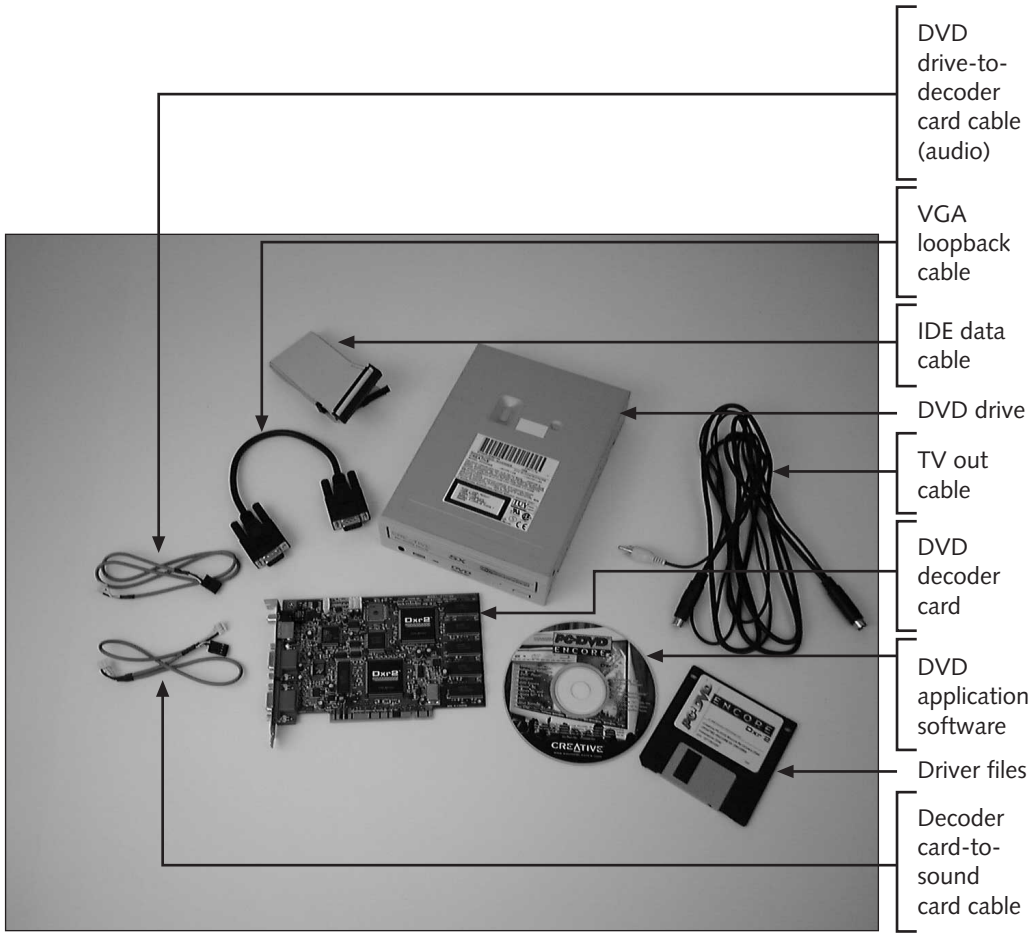

Figure 15-40 Parts that are included in the DVD drive kit

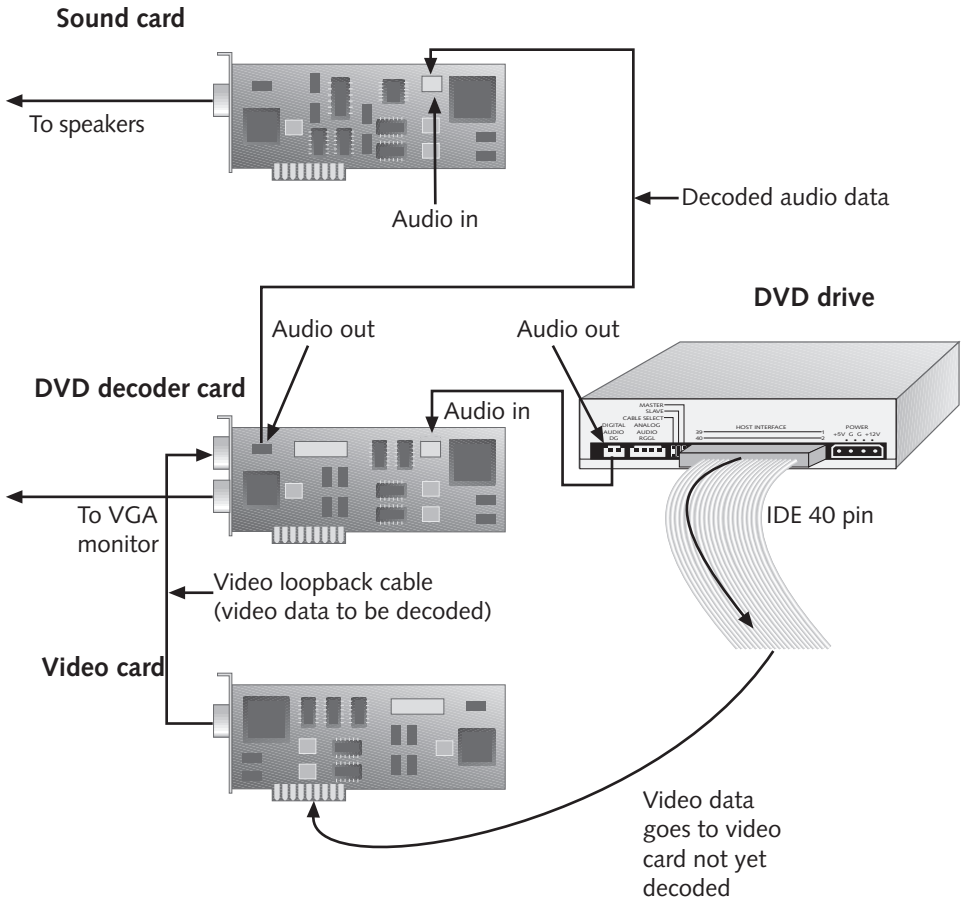

Figure 15-41 Data flow in the DVD subsystem

To help make the final installation of parts easier to visualize, we set up the installation outside the case and took the photo shown in Figure 15-42. This photo was taken simply to help you understand the final installation. No power was turned on while the components were in this position!

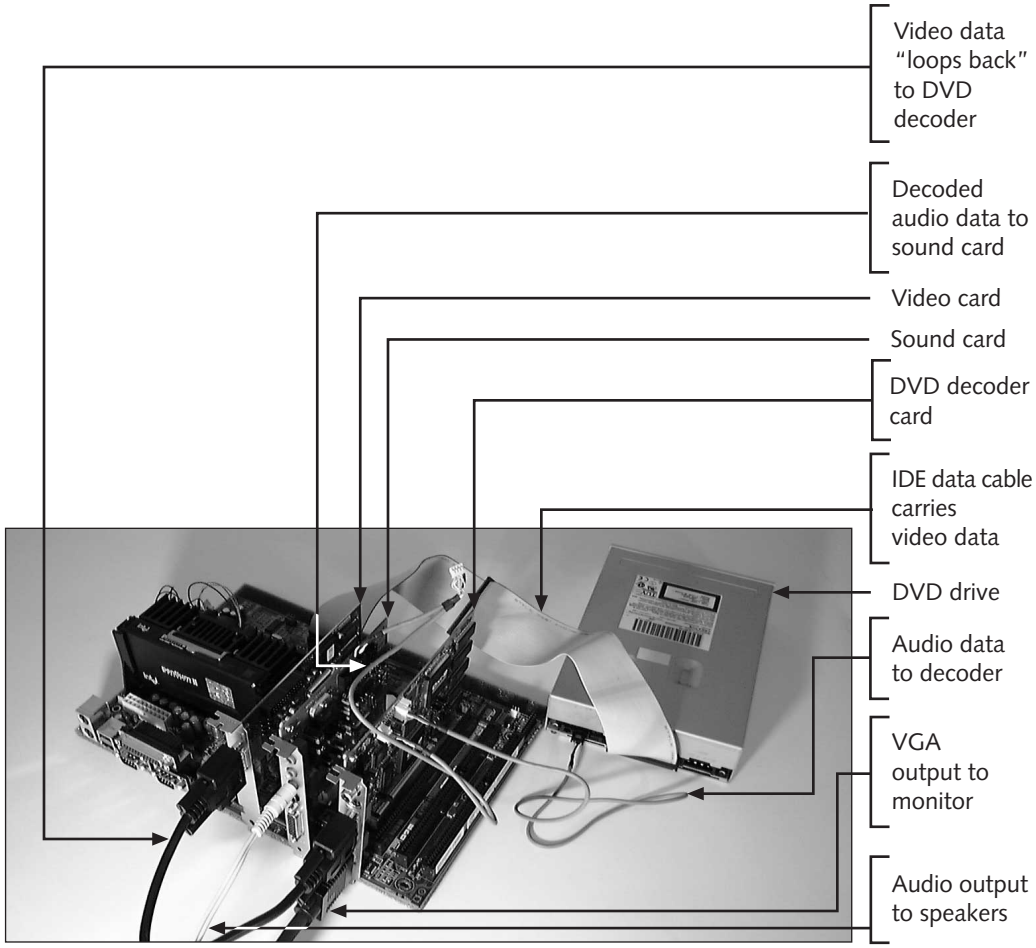

Figure 15-42 The complete DVD subsystem, including the drive (right) and various components installed on the system board (left)

The DVD decoder card (Figure 15-43) has connections for audio in, audio out, video in, and video out. In addition, there are two other external ports, one for TV out and one for Dolby digital sound out. Use the TV out port to play DVD movies from your PC, and the Dolby port if you have a Dolby speaker system. Recall from Chapter 10 that a Dolby sound system, which is the standard sound for DVD audio data, can use up to six speakers on six separate audio tracks to provide a rich theater-like sound.

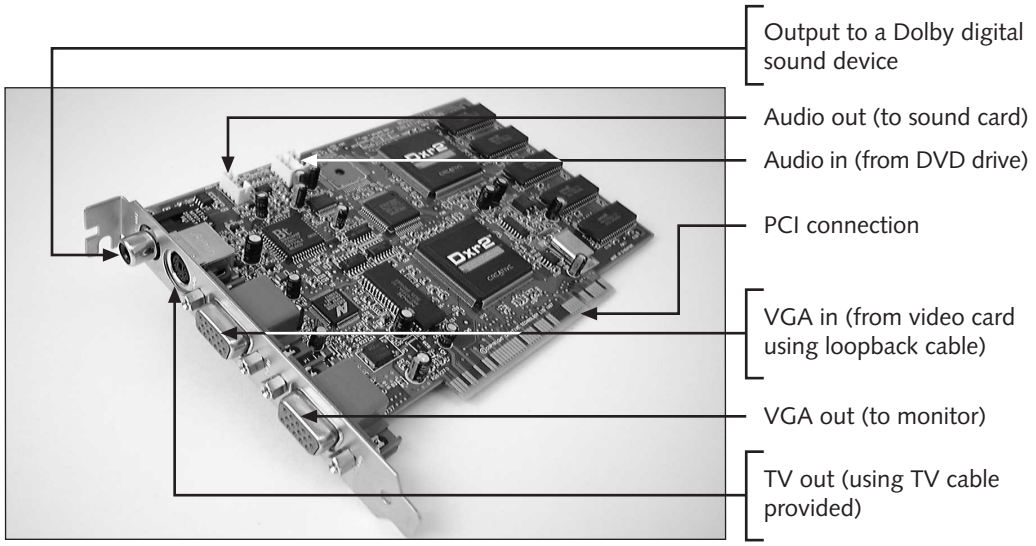

Figure 15-43 DVD decoder card

The rear of the DVD drive is shown in Figure 15-44, and a diagram of the rear panel is shown in Figure 15-45. Looking closely at Figure 15-44, note that the jumper is set so that the drive will be a slave on the IDE connection.

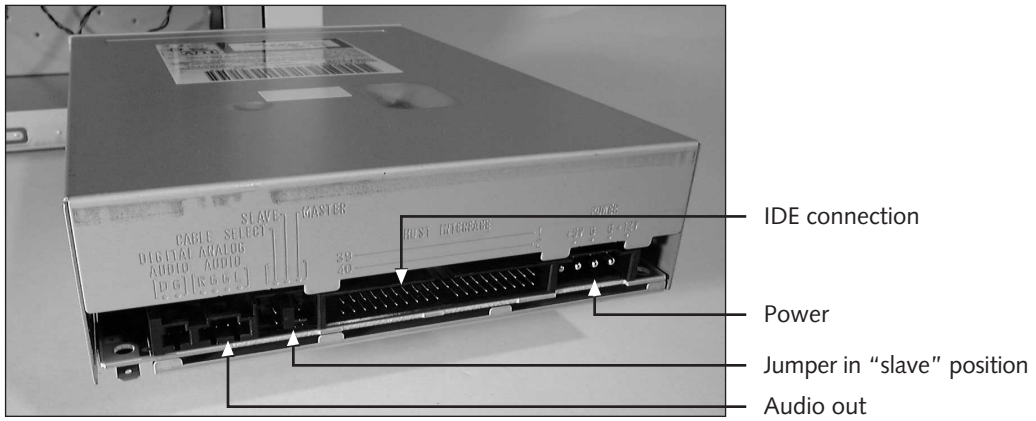

Figure 15-44 Rear of DVD drive (see Figure 15-45 for an explanation of each connection)

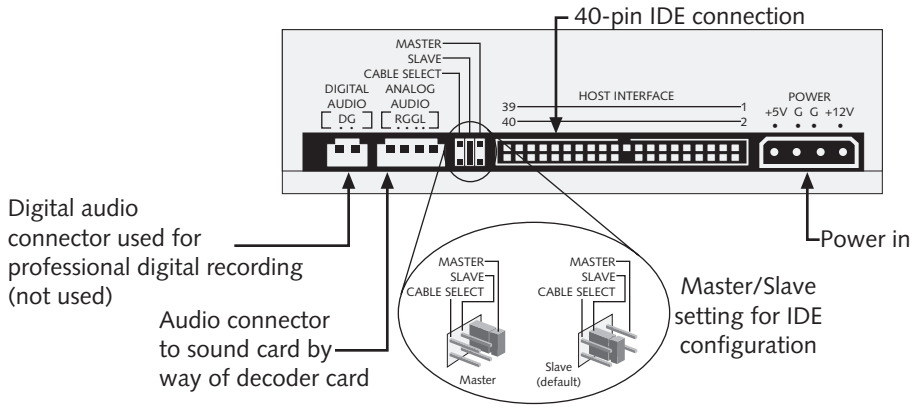

Figure 15-45 Rear panel of the DVD drive

Looking at the location of the bay for the DVD drive, we decide to connect the audio cable first, slide the drive into the bay, and then connect the remaining cable and cord. Survey your own situation for the best approach. Follow these steps to install the DVD components:

- Confirm that the jumper on the DVD drive is set to slave (the default setting).
- Connect the DVD drive audio cord to the analog audio connection on the rear of the drive.
- Remove the faceplate on the front of the computer case covering the bay opening.
- Slide the drive into the bay from the front of the bay (Figure 15-46).

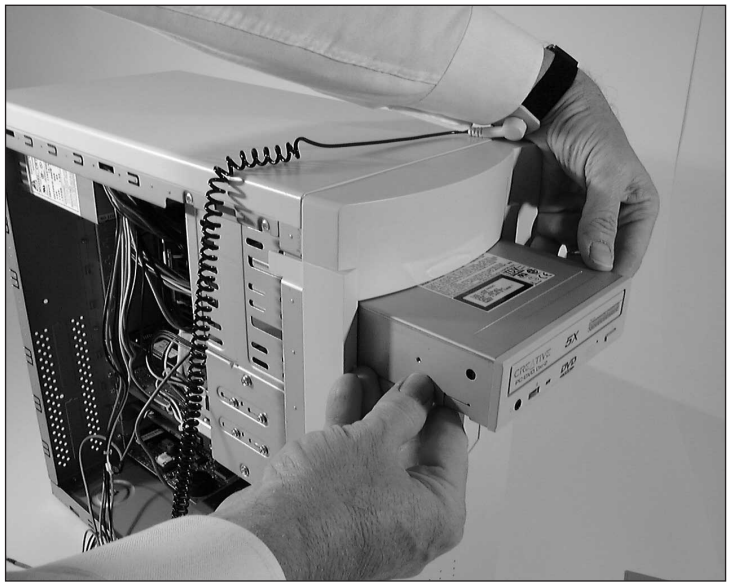

Figure 15-46 Slide the DVD drive into the bay

- Secure the drive in the bay with two screws on each side of the drive.
- Attach the IDE data cable to the drive, being careful to align the edge color of the cable with pin 1 on the drive (Figure 15-47).

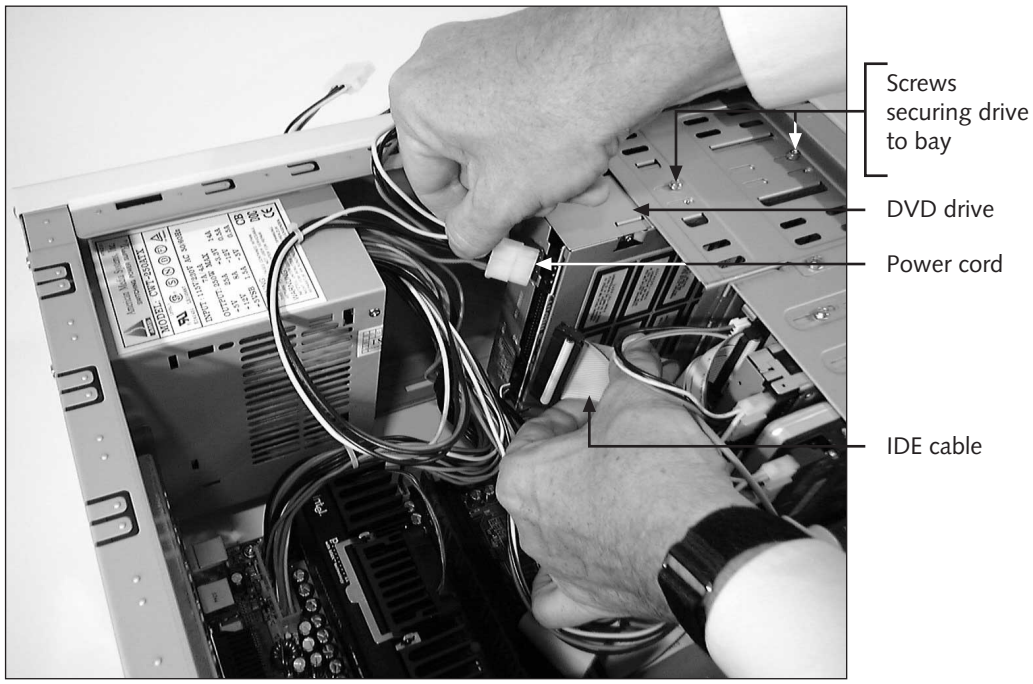

Figure 15-47 After the DVD drive is secured in its bay, attach the IDE data cable and power cord

- Connect a power cord to the power connection on the drive.
- Connect the audio cord coming from the DVD drive to the audio in connection on the DVD decoder card.
- Connect the second audio cord first to the audio out connection on the DVD decoder card and then to the audio in connection on the sound card (refer back to Figure 15-42). The cord has two plugs at the sound-card end. Select the plug that fits the sound-card connection.
- Insert the DVD decoder card in a PCI expansion slot and secure it with a screw.

That completes the DVD subsystem installation inside the computer case. Later, when you are ready to use the DVD system, install the video loopback cable (see Figure 15-48), which presents video data to the DVD decoder for decoding before the decoder sends the video data on to the monitor.

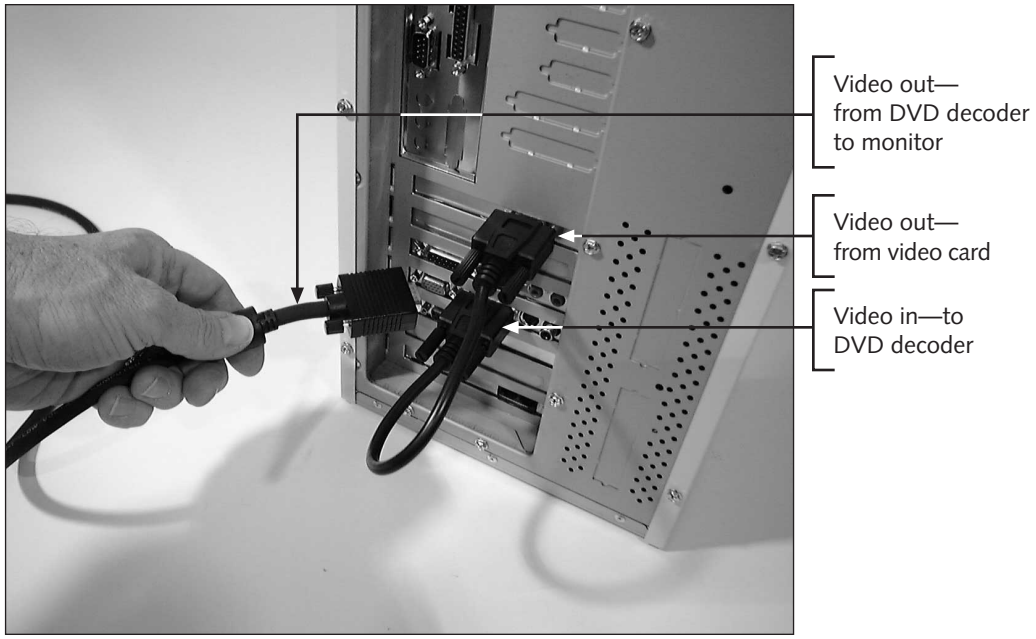

Figure 15-48 The video loopback cable installed in the DVD subsystem

Step 10: Connecting Other Essential Peripherals

The installation inside the case is now complete (Figure 15-49). Install the case cover next. In our installation, the case cover is two panels that fit on each side of the case. Slide the panels into position (Figure 15-50) and secure them with screws on the back of the case. Next, connect the mouse, keyboard, speakers, and monitor, and then install the operating system and drivers for each hardware device that needs one, and then the applications software. You might want to power up the PC and make sure it is operating before you install the case cover, in order to ensure that everything inside the case is working.

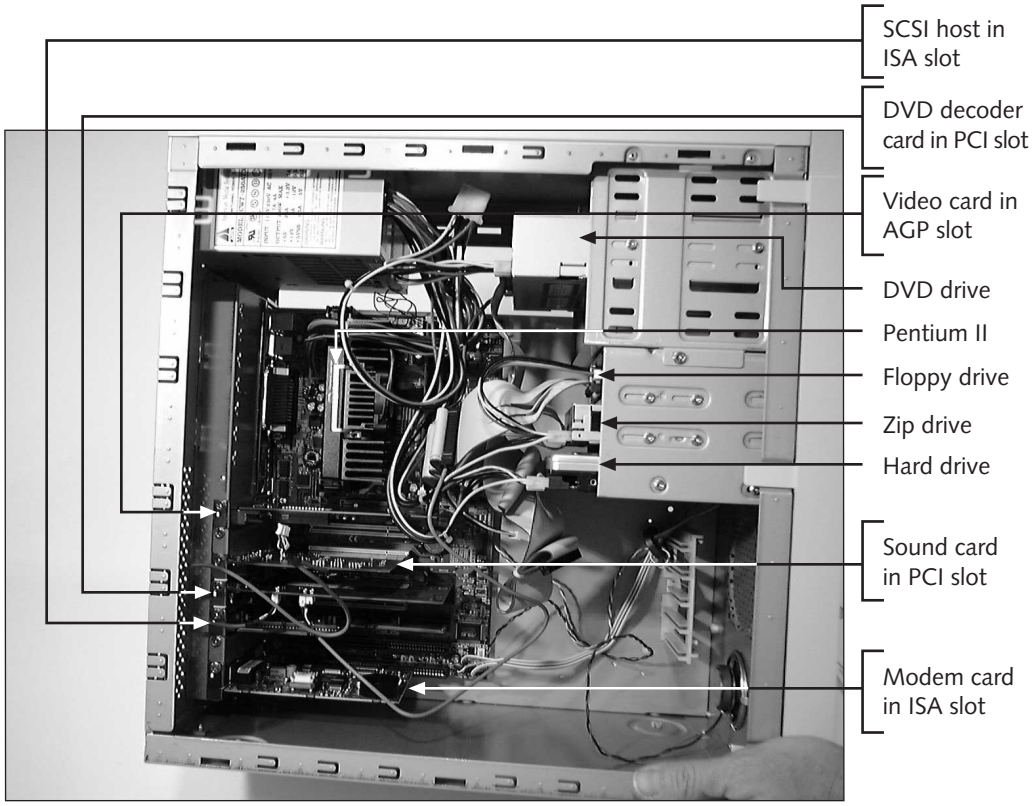

Figure 15-49 All components installed inside the case

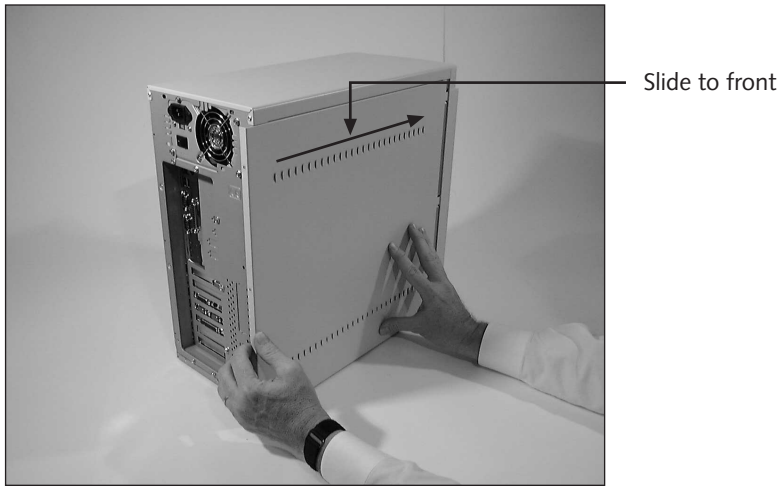

Figure 15-50 Install the panels on the sides of the computer case

With older system boards, when you first turn on the PC, you must go to CMOS setup and configure the system. With newer system boards using autodetection, this should not be necessary.

Step 11: Installing the Operating System

A+ OS 2.1

When you first turn on a brand-new PC, nothing is written to the hard drive, so you must boot from a floppy disk. We are installing Windows 98 from a CD and are using the DVD drive to read the CD. The floppy disk must have the necessary drivers on it to support the DVD drive while Windows 98 is being installed. (The same files that support a CD-ROM drive can support a DVD drive so the drive can read a CD.) Later, after the OS is installed, we can then install the DVD drivers under Windows.

We need a boot disk that contains enough DOS to partition and format the hard drive, and drivers to support the DVD drive in order to read a CD from which Windows 98 can be installed. Table 15-2 lists the files on the disk that are required. In addition, it is wise for the disk to have other files that Windows normally puts on an emergency startup disk.

The command in AUTOEXEC.BAT to load the DOS CD-ROM extender is:

```
MSCDEX.EXE /D:MYTAG /L:E /M:10
```

The command in CONFIG.SYS to load the CD-ROM driver is:

```
DEVICE=MTMCDAI.SYS /D:MYTAG
```

Including the /L parameter in the first command will assign E as the drive letter for the DVD drive. For more information about CD-ROM drivers, see Chapter 10.

Table 15-2 Files needed on the bootable disk to start the load process

Files	Description
COMMAND.COM, IO.SYS, MSDOS.SYS	DOS 7.1 files necessary to boot
AUTOEXEC.BAT and CONFIG.SYS	Needed to load device driver to support the DVD drive and to load Himem.sys so there is enough memory available to DOS to support the DVD drive and format the hard drive
MSCDEX.EXE and MTMCDAI.SYS	DOS extender and a device driver that together allow the DVD drive to "act like" a CD-ROM drive (just about any CD-ROM driver would work in place of the MTMCDAI.SYS file used here)
HIMEM.SYS	Allows access to extended memory that is needed by DOS and drivers
FDISK.EXE and FORMAT.COM	Needed to partition and format the hard drive

Follow these steps to format the hard drive and load the operating system:

- Prepare a bootable disk with the files listed in Table 15-2.

A+ OS 2.1

- Turn on the PC. You should see the BIOS count up memory to 64 MB, recognize the three IDE devices, and list the PCI devices installed, together with the resources assigned to them. It should then boot from the floppy disk and come to an A prompt.
- Run FDISK and partition the hard drive.
- Run FORMAT C:/S to format the hard drive and enable it to boot DOS 7.
- Run Windows 98 Setup from the CD in the DVD drive.

Step 12: Connecting Remaining Peripherals and Installing Device Drivers

After Windows 98 is installed, install the drivers for the sound card, video card, DVD drive, Zip drive, and modem. Next, connect the remaining peripherals, including the speakers and scanner. When connecting the scanner to the SCSI connection, include a terminating resistor at the scanner end. Figure 15-51 shows the terminating resistor being attached to the end of the SCSI cable that will then attach to the scanner.

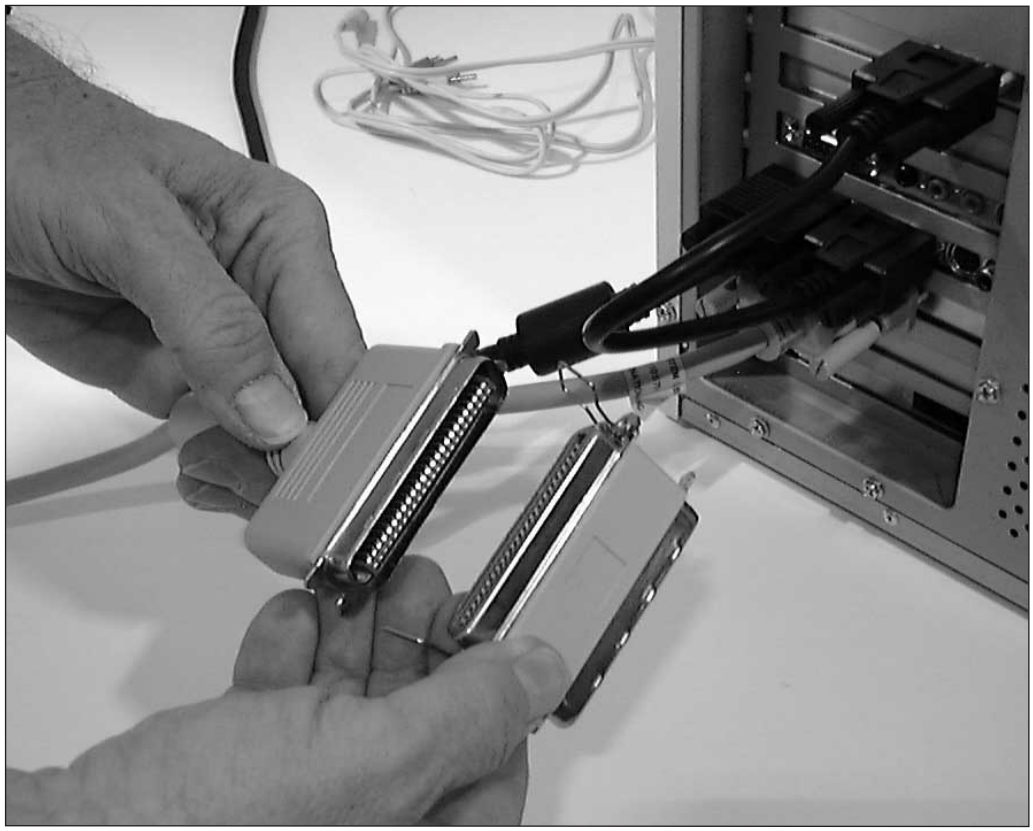

Figure 15-51 Include a terminating resistor at the scanner end of the SCSI chain

Connect the video camera to the USB port and install the video camera software. Figure 15-52 shows the completed system.

Figure 15-52 The completed system

JumperFree System Board Installation

A+CORE 1.2, 1.8

Some system boards do not use jumpers to configure the system board and CPU frequencies. For example, look at the system board shown in Figure 3-3 in Chapter 3, which has a Pentium III processor installed. The processor runs at 667 MHz, and the system board is configured to run at 133 MHz. You can configure the system board by using a bank of DIP switches on the board, as shown in Figure 15-53, or you can use CMOS setup to configure the board, which is called JumperFree mode. The board has a single group of jumpers, shown in Figure 15-54. Use this group of jumpers to enable and disable JumperFree mode. When the cap is over pins 1 and 2, JumperFree mode is enabled; when the cap is over pins 2 and 3, JumperFree Mode is disabled.

A+CORE 1.2, 1.8

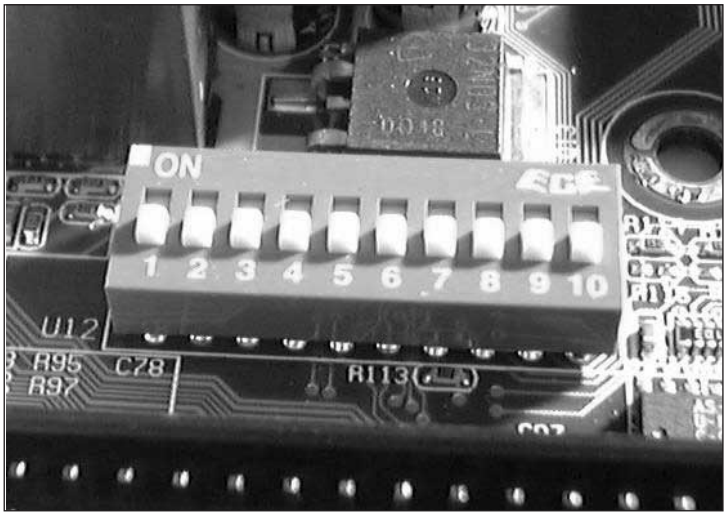

Figure 15-53 A system board can use a bank of DIP switches for configuration settings

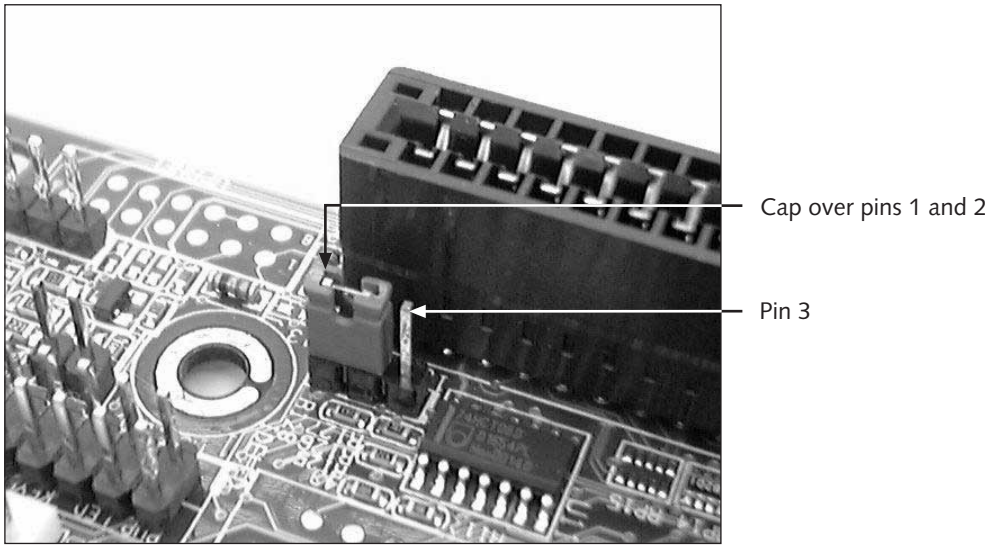

Figure 15-54 Because pins 1 and 2 are covered, the JumperFree mode is enabled

If you do not want to use JumperFree mode, set the jumpers to disable the feature and use the DIP switches to control the configuration. Figure 15-55 shows the documentation for this system board with the possible configurations for the system. Because this system has a 667 MHz Pentium III processor, the second row is selected in the table, and the ten DIP switches are then set to off, off, off, off, on, off, off, on, on, and off, according to the table.

A+CORE 1.2, 1.8

				(CPU BUS Freq.)				(Freq. Multiple)				AGP	
Intel CPU Model	**Freq.**	**Mult.**	**BUS F.**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**	**5**	**6**
Pentium III	733MHz	5.5x	133MHz	[OFF]	[OFF]	[OFF]	[OFF]	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[OFF]
Pentium III	667MHz	5.0x	133MHz	[OFF]	[OFF]	[OFF]	[OFF]	[ON]	[OFF]	[OFF]	[ON]	[ON]	[OFF]
Pentium III	700MHz	7.0x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[OFF]	[ON]	[OFF]	[ON]	[OFF]
Pentium III	650MHz	6.5x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[OFF]	[ON]	[ON]	[OFF]	[ON]	[OFF]
Pentium III	600MHz	6.0x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[ON]	[ON]	[OFF]	[ON]	[OFF]
Pentium III	550MHz	5.5x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[OFF]
Pentium III	500MHz	5.0x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[OFF]	[OFF]	[ON]	[ON]	[OFF]
Pentium II/III	450MHz	4.5x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[OFF]	[ON]	[OFF]	[ON]	[ON]	[OFF]
Pentium II	400MHz	4.0x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[ON]	[ON]	[OFF]	[ON]	[ON]	[OFF]
Pentium II	350MHz	3.5x	100MHz	[OFF]	[OFF]	[OFF]	[ON]	[OFF]	[OFF]	[ON]	[ON]	[ON]	[OFF]
Celeron	466MHz	7.0x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[ON]	[OFF]	[ON]	[OFF]	[ON]	[OFF]
Celeron	433MHz	6.5x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[OFF]	[ON]	[ON]	[OFF]	[ON]	[OFF]
Celeron	400MHz	6.0x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[ON]	[ON]	[ON]	[OFF]	[ON]	[OFF]
Pentium II/Celeron	333MHz	5.0x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[ON]	[OFF]	[OFF]	[ON]	[ON]	[OFF]
Pentium II/Celeron	300MHz	4.5x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[OFF]	[ON]	[OFF]	[ON]	[ON]	[OFF]
Pentium II/Celeron	266MHz	4.0x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[ON]	[ON]	[OFF]	[ON]	[ON]	[OFF]
Pentium II	233MHz	3.5x	66MHz	[OFF]	[OFF]	[ON]	[ON]	[OFF]	[OFF]	[ON]	[ON]	[ON]	[OFF]

Use this selection for a Pentium III CPU rated at 677Mhz

For updated processor settings, visit the ASUS Web site

Figure 15-55 When not using JumperFree mode, set DIP switches according to the internal speed of your processor

To use JumperFree mode, set the jumpers to JumperFree mode and set all DIP switches to off. When you boot the PC, access CMOS setup and configure the system board by using the Advanced Setup screen, shown in Figure 15-56. For example, for this system board, set the CPU Speed to 667 MHz, the CPU System Frequency Multiple to 5.0x, and System/PCI Frequency to 133.9/33.25 MHz. To select these settings, follow the directions at the bottom of the setup screen.

Incidentally, this system board has a unique way to reset CMOS when you need to erase a forgotten password and return the CMOS settings to the default values. Rather than using two jumper pins as does the system board shown earlier in the chapter, this system board uses two solder pads positioned very close to the round lithium battery. Turn the system off, place a small screwdriver across the pads, remove the screwdriver, and reboot the system.

A+CORE 1.2, 1.8

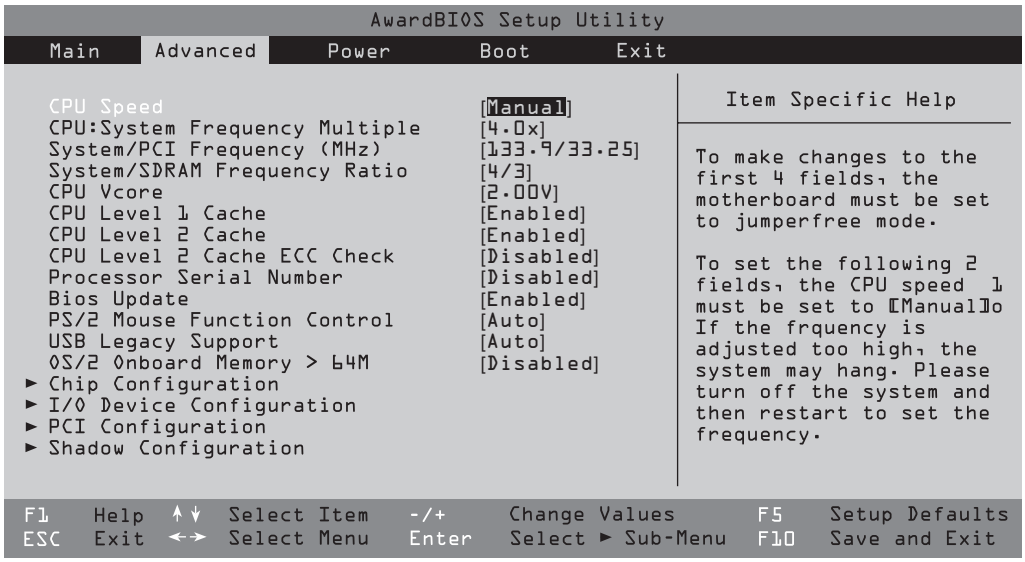

Figure 15-56 When the system board is set to JumperFree mode, use CMOS setup to select CPU speed and frequency ratios

CHAPTER SUMMARY

- The most common reason to buy a brand-name PC rather than a clone is after-sales service.
- Many brand-name PCs use proprietary designs that force you to use only that particular brand name's parts and service when upgrading or maintaining the PC.
- Middle-range PCs offer more network capability, more expandability, more support, and more prior testing than do low-end PCs.
- Some reasons to build your own PC are the knowledge you will gain, the control you will have over the choice of individual parts, the availability of documentation and original software disks, and the satisfaction of having built the PC yourself.
- When choosing to build your own PC, be aware that the process will take time, that you will likely encounter problems along the way, that there will be no warranty on the assembled product, and that you probably will not save money.
- Plan the project of assembling a PC well. Get answers to any questions you may have on the details before you begin. Keep things organized as you work. Expect the project to be fun.
- When assembling a PC, follow this general plan:
  - Study the system-board documentation and set all jumpers.
  - Verify that the system board, CPU, and memory are all working before installing the system board in the case.

- Install the system board, panel connections, and power cord.
- Install the drives (floppy drive, hard drive, CD-ROM drive, etc.).
- Install the sound card, modem, and any other cards, including the video card.
- Connect the peripherals.
- Install the operating system and device drivers.

Key Terms

Clone — Originally, a computer that was compatible with IBM computer hardware and MS-DOS software. Today, the word *clone* often refers to no-name Intel and Microsoft compatibles.

IBM-compatible — A computer that uses an Intel (or compatible) processor and can run DOS and Windows.

Proprietary — A term for products that a company has exclusive rights to manufacture and/or market. Proprietary computer components are typically more difficult to find and more expensive to buy.

Standoffs — Small plastic or metal spacers placed on the bottom of the main system board, to raise it off the chassis, so that its components will not short out on the metal case.

Review Questions

1. What are the advantages of buying a well-known, brand-name computer?
2. What are the advantages of buying a less-expensive PC clone?
3. List three reasons why it may be wise to build your own PC. List three reasons, other than fear, why you may not want to build your own PC.
4. When building a new computer, you may have to change jumper settings on the system board. List two reasons for this.
5. What rule must be followed when connecting the power supply cables to the system board?
6. What is the maximum number of IDE devices that can be installed on a system?
7. What should you do before switching on the power of a freshly assembled system?
8. List several LED connectors that are typically attached to a system board.
9. What rule must be followed when attaching drive cables?
10. List five port connectors that are commonly built into most system boards today.
11. Is floppy drive A attached to the middle cable connector or the end cable connector of the floppy drive cable?
12. In a system that uses a CD-ROM drive instead of a DVD drive, the audio wire connects the _____ to the _____.

13. What will be the SCSI ID of a host adapter on the SCSI chain?
14. Where and when are SCSI terminating resistors attached?
15. Assume that you are shopping for a new personal computer. Answer the following questions to help in making the best buying decision.
    a. What is the intended purpose or purposes of the computer?
    b. What functions must the computer have to satisfy each intended purpose?
    c. What hardware and software components are needed to perform each function?
    d. For each hardware and software component, what is one question that you want answered about the component before you make your decision?
16. What is the maximum number of PCI cards that can be installed in the PC system assembled in this chapter?
17. What is the purpose of performing the memory test before installing the system board in the computer case?
18. If the memory test failed, list three possible causes of the failure.
19. What would be the jumper settings for the SCSI card if configured to use IRQ 11?
20. If the floppy drive cable were installed with the edge color opposite pin 1 instead of next to it, what would be the result?

PROJECTS

Practicing Computer Assembly Skills

Work with a partner. With your partner not watching, carefully write down where every wire and cable inside your computer is connected. Disconnect all cable connections: power, drives, and LED indicators. Have your partner replace each connection without your help. Work together with your partner to carefully inspect the connections, using your diagram as an aid. Reboot and test the computer.

Planning an Upgrade

Using a system-board manual, write down what jumper changes must be made to upgrade a CPU or to upgrade memory cache.

Troubleshooting an Assembly Problem

After assembling the PC shown in this chapter, we found that the floppy drive did not work, and the light on the front of the drive stayed on. Troubleshoot the problem by comparing Figure 15-30 to the rear of a floppy drive.

Planning to Buy Parts for a PC

Price the following parts needed to build a PC:

- System board for a Pentium CPU
- Pentium III CPU
- 128 MB of RAM
- Hard drive with at least 8 GB of storage
- Floppy disk drive
- CD-ROM drive
- Computer case and power supply
- Video controller card
- Sound card

List the features of the system board, CPU, and RAM you chose.

What speed is the CD-ROM drive you selected?

Identify and price at least one other device to install inside the computer case that you would want on your own PC.

As you price each part, if you select a high-end (more expensive) part rather than a low-end (less expensive) one, list the feature on the part that caused you to plan to spend the extra money.

Upgrading Memory

Looking back at the documentation in the chapter for the system board, what memory modules would you buy, and how much would it cost to upgrade RAM from 64 MB to 128 MB?